The Canadian Albacore Tuna Catch and Effort Relational Database

M. Stocker, H. Stiff, W. Shaw, and A.W. Argue

Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
Nanaimo, BC
V9T 6N7

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by

M. Stocker[1], H. Stiff[2], W. Shaw[3], and A. W. Argue[4]

[1]Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C. V9T 6N7

[2]1960 Murray Road
Gabriola, B.C. V0R 1X7

[3]Fisheries and Oceans Canada
Fisheries Management Branch
South Coast Division
3225 Stephenson Point Road
Nanaimo, B.C. V9T 1K3

[4]Argus Bio-Resources Limited
4050 Lockehaven Dr
Victoria, B.C. V8N 4J5

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TABLE OF CONTENTS

LIST OF FIGURES ..... **IV**

LIST OF TABLES ..... **V**

LIST OF APPENDICES ..... **V**

ABSTRACT ..... **VI**

RESUME ..... **VI**

1. INTRODUCTION **1**

2. BACKGROUND **2**

2.1. DESCRIPTION OF THE FISHERY 2
2.2. FISHERY DATA MANAGEMENT 2

3. DATABASE MANAGEMENT SYSTEM **4**

3.1. DATA SOURCES 4
3.1.1. Logbooks *5*
3.1.2. Sales Slips *5*
3.1.3. Hail Data *6*
3.1.4. Trans-shipment Data *6*
3.1.5. Unreported Vessels Data *7*
3.1.6. Supplemental Data *7*
3.2. DATABASE DEVELOPMENT 7
3.2.1. Conceptual Data Model *8*
3.2.1.1. Catch and Effort Sources *8*
3.2.1.2. Calculating Catch and Effort for Unique Vessels *9*
3.2.1.3. Reported Catch and Effort Undefined By Area *10*
3.2.1.4. Effort and Catch per Effort *10*
3.2.1.5. Expanding the Unique Vessels Fishing *10*
3.2.1.6. Expanding the Catch and Effort *11*
3.2.1.7. Summarizing Vessels, Catch and Effort *12*
3.2.2. Physical Data Model *12*
3.2.2.1 System Requirements *13*
3.2.2.2. File Organization *13*
3.2.2.3. Database Data Structures *13*
3.2.2.4. Data Relationships *14*
3.2.2.5. Codebase Objects *15*
3.3. DATA ENTRY, EDITING, VALIDATION AND QUALITY CONTROL 15
3.3.1. Triplogs *15*
3.3.2. Saleslips *16*
3.3.3. Hails *16*
3.3.4. Data Reconciliation *16*

4. DATA ANALYSIS **17**

4.1. Reported Catch and Effort *17*
4.2. Expanded Catch and Effort *17*
4.3. Reporting Details *18*
4.4. Catch and Effort Spatial Analysis for Export to GIS *19*

5. DISCUSSION **20**

5.1. POST-SEASON AND IN-SEASON ANALYSES 20
5.2. COMPARISON OF ESTIMATES 20
5.3. ADDRESSING POTENTIAL SOURCES OF ERROR 20

7. LITERATURE CITED 23
8. FIGURES 25
9. TABLES 50
10. APPENDICES 59

LIST OF FIGURES

Figure 1. Albacore tuna catch and effort relational database diagram 26
Figure 2. Triplog data entry form 27
Figure 3. Saleslip data entry form 28
Figure 4. Food and Agricultural Organization (FAO) fishing areas 29
Figure 5. DFO Albacore Tuna Fishing Areas within the FAO fishing areas 29
Figure 6. Venn diagram demonstrating the intersection of fisher logbook (triplogs) and landed catch (saleslip) data subsets 30
Figure 7. Expanded Venn diagram demonstrating the intersection of fisher logbook (triplogs) and landed catch (saleslip), and hail data subsets 30
Figure 8. Reported and expanded albacore catch estimates, 1995-2005 31
Figure 9. Triplog data analytical flow model: (a) pseudo-code; (b) database objects 32
Figure 10. Saleslips analytical flow model: (a) pseudo-code; (b) database objects 34
Figure 11. Unique vessels analytical flow model: (a) pseudo-code; (b) database objects 36
Figure 12. Hail data analytical flow model: (a) pseudo-code; (b) database objects 38
Figure 13. Catch and effort analytical flow model (saleslips-based approach): (a) pseudo-code; (b) database objects 40
Figure 14. Catch and effort analytical flow model (triplog-based approach): (a) pseudo-code; (b) database objects 44
Figure 15. Analytical flow model for catch, effort, and CPUE by year-vessel-trip-date at latitude and longitude coordinates, for export to geographical information systems (GIS): (a) pseudo-code; (b) database objects 46
Figure 16. Reported and expanded albacore catch as a function of percent of vessels reporting 48
Figure 17. Saleslip trip catch weight as a function of triplog trip catch weight, 1995-2005 49
Figure 18. Comparison of post-season catch estimates based on triplog-based approach ($T+Y$) and saleslip-based approach ($S+X$) 49

LIST OF TABLES

Table 1. Total reported catch, supplemental catch, and percent supplemental of total catch, 1995-2005.....50

Table 2. DFO Albacore Tuna Fishing Areas and associated FAO areas.....50

Table 3. Annual record of unique vessels fishing and percent of vessels submitting triplogs in Canadian albacore tuna fishing fleet.....51

Table 4. Example catch and effort summary report (*T+Y* method).....52

Table 5. Example catch and effort summary report (*S+X* method).....53

Table 6. Logbook data form used on albacore tuna fishery vessels, 2006.....54

Table 7. Saleslip data form used in the albacore tuna fishery.....55

Table 8. Example catch and effort summary report for the month of July (*T+Y* method).....56

Table 9. Correlation and regression analysis of saleslip landings as a function of triplog landings, by year, vessel, and trip.....57

LIST OF APPENDICES

Appendix 1. Historical Canadian albacore tuna jig-troll catch (tonnes), 1939-1994.....59

Appendix 2. Canadian albacore tuna jig-troll catch summary reports, 1995-2005.....60

Appendix 3. Albacore Relational Database – Data Table Field Properties and Data Structure.....71

Appendix 4. Albacore Relational Database – Lookup Table Field Properties and Data Structure.....75

ABSTRACT

Stocker, M., Stiff, H., Shaw, W., and Argue, A.W. 2007. *The Canadian Albacore Tuna Catch and Effort Relational Database*. Can. Tech. Rep. Fish. Aquat. Sci. 2701: vi + 76 p.

The *Canadian Albacore Tuna Catch and Effort Relational Database Management System* was developed by Fisheries and Oceans Canada to address the issues of tracking albacore catch and effort data from fishing logbooks and sales slips landings from the Canadian troll fleet operating in the Pacific Ocean. This document provides an overview of the structure and function of the database. The description includes a *conceptual data model*, which defines the logical relationship of fields and tables, and a *physical data model*, which describes the hardware/software implementation of the conceptual model. The description includes an outline of the data compilation, formulation, and summary procedures used to convert raw fishery data into an expanded catch and effort estimate at geospatial coordinates. Two analytical approaches to catch and effort estimation are presented which depend on the relative availability of saleslip and logbook data sources. Limitations and potential sources of error for each method are discussed.

RESUMÉ

Stocker, M., Stiff, H., Shaw, W., and Argue, A.W. 2007. *The Canadian Albacore Tuna Catch and Effort Relational Database*. Can. Tech. Rep. Fish. Aquat. Sci. 2701: vi + 76 p.

Pêches et Océans Canada a mis sur pied le Système canadien de gestion de base de données relationnelles sur les prises et l'effort de pêche du germon (Canadian Albacore Tuna Catch and Effort Relational Database Management System) dans le but de régler les problèmes liés à la traçabilité des données sur les prises et l'effort de pêche du germon provenant des journaux de bord des ligneurs canadiens pêchant dans le Pacifique et des bordereaux d'achat des débarquements. Nous faisons dans le présent document un survol de la structure et de la fonction de la base de données. La description inclut un *modèle conceptuel de données*, qui définit la relation logique des champs et des tableaux, et un *modèle de données réelles*, qui décrit la mise en œuvre logicielle et matérielle du modèle conceptuel. La description inclut également un survol des procédures de compilation, de présentation et de synthèse des données utilisées pour convertir les données brutes sur la pêche en des estimations pondérées des prises et de l'effort selon des coordonnées géospatiales. Nous présentons deux approches analytiques d'estimation des prises et de l'effort, qui reposent sur la disponibilité relative de données de bordereaux d'achat et de journal de bord, et nous établissons les limites et les sources potentielles d'erreur pour chacune.

1. INTRODUCTION

This document describes the catch data management processes for the Canadian albacore troll jig fishery in the Pacific ocean.

Canada has a long history of fishing for North Pacific albacore tuna (*Thunnus alalunga*), one of five species of highly migratory tunas that support some of the most lucrative fisheries in the world (Joseph et al. 1988). The first recorded albacore landings by British Columbia jig-troll vessels were in 1939 (Anonymous 1917-1950). These early statistics were incomplete compared to the catch statistics since 1995, the period for which the database described in this report was constructed.

The mid-1990s was a time of increased international concerns over growing, unregulated fisheries for highly migratory species (HMS) in the Pacific Ocean. Renegotiation of the *Inter-American Tropical Tuna Convention* for waters east of 150°E longitude was underway as was negotiation of a new western Pacific convention for HMS fisheries west of 150°E longitude.

Canada is committed to providing detailed catch and effort statistics, logbook data, and fishing vessel information, as required under various international agreements. The Convention for the Conservation of Highly Migratory Fish Stocks in the Western and Central Pacific was negotiated to conserve and manage highly migratory species in the central and western Pacific Ocean. Canada ratified the Convention on November 1, 2005, becoming the 22nd member of the Western and Central Pacific Fisheries Commission (WCPFC). The most important aspect of the WCPFC for Canada is the management of the northern albacore tuna fishery. The Canadian fishery occurs within the WCPFC and the adjacent Inter-American Tropical Tuna Commission (IATTC) Convention Areas and in the US and Canadian exclusive economic zones (EEZ). The IATTC, established by international convention in 1950, is responsible for the conservation and management of fisheries for tunas and other species taken by tuna-fishing vessels in the eastern Pacific Ocean. Currently Canada is a Cooperating Non-Party in the IATTC.

The *Canadian Albacore Tuna Catch and Effort Relational Database* is the instrument used to comply with the obligations of data provision to these international bodies. In 1998, DFO began construction of the relational database that would be used to compile albacore catch and effort from sales slips, log books, and hail data. The idea was to combine these three data sources in order to account for all Canadian catches from high seas areas, the EEZ off British Columbia, and each of the US Pacific northwest states.

Section 2 of this report provides background information on the history of the Canadian albacore tuna fishery and data collection. In Section 3, we describe the *Canadian Albacore Tuna Catch and Effort Relational Database*, designed to provide annual catch estimates for the Canadian albacore troll fishery based on sales slips, log books, and hail information. The description includes a conceptual data model, which outlines the logical relationship of fields and tables, and a physical data model, which describes the hardware/software implementation of the conceptual model. Section 4 includes an outline of the data compilation, formulation, and summary procedures used to convert raw fishery data into an expanded catch and effort estimate at geospatial coordinates, and summarized by fishing area. Section 5 provides a discussion of the potential sources of

error in data sources and compilation, and the implications for using the database for in-season and post-season analyses.

2. BACKGROUND

2.1. Description of the Fishery

The Canadian fishery for albacore tuna commenced as a coastal fishery in the waters off British Columbia (B.C.). It is now comprised of two fleet types, smaller vessels fishing coastal B.C. and USA waters, and larger vessels fishing on the high seas of the north and south Pacific Ocean. Geographical designations for DFO and associated UN FAO (United Nations Food and Agricultural Organization) fishing areas are listed in Table 1.

The coastal fleet operates within the Canadian EEZ and the USA EEZ in accordance with fishing and port access privileges under the treaty. Vessels in this fleet, mostly 10.67 m to 18.29 m in length (35 to 60 feet), concentrate their fishing effort primarily from the southern Oregon coast to the northern tip of Vancouver Island (Stocker and Shaw 2005). Fishing activity is dependent on price, ocean and weather conditions, albacore availability, the strength of other fisheries, particularly the salmon fishery, and fuel costs (Argue et al. 1999). Effort in the coastal fishery normally peaks in September, after the salmon season for trollers has wound down. Catch from the coastal fleet is sold into both the canned and the blast bled frozen tuna markets (Stocker and Shaw 2005).

The Canadian high seas fleet is comprised of larger troll vessels, mostly greater than 60 feet in length, with crews typically of two to four fishers. These vessels typically remain at sea for trips of several months. Many of these vessels are equipped with larger freezers and operate primarily from west of the International Dateline to the Canadian EEZ in the north Pacific. Some offshore vessels trans-ship their catch to carrier vessels at sea in order to continue fishing operations on migrating schools of tuna. Offshore vessel catches are sold primarily into the blast bled frozen sashimi market. The north Pacific fishery operates primarily in May - October each year when albacore are abundant offshore and in coastal waters. The south Pacific fishery lasts from December - March (Stocker and Shaw 2005).

Two to five vessels operate in the south Pacific, 20 to 30 vessels fish in waters outside the Canadian and USA EEZ to as far west as 170°E in the north Pacific and 130 to 179 vessels troll the waters of the USA EEZ, for a total of up to 230 vessels in the coastal waters. In total, there are about 350 unique Canadian vessels that have participated in the albacore fishery in at least one year since 1995.

Catches since 1996 by the Canadian fleet in the north Pacific albacore troll fishery have ranged from 3,591 tonnes in 1996 to 7,842 tonnes in 2004, with an average catch of 4,403 tonnes. Between 100 and 400 tonnes of this catch are taken in the south Pacific. Canadian caught albacore is worth up to $28 million per year in landed value.

2.2. Fishery Data Management

Prior to 1951, fish landings were developed from statistics on the amount of products produced by Canadian processing companies (Appendix 1). Fisheries and Oceans Canada (DFO) calculated landings by converting products to landed weights using

industry standard conversion factors (Argue and Shepard 2005). DFO attempted to assign landings to catch areas with varying success; and there were instances of products (and landings) being double counted (A.W. Argue, unpublished data). Canadian caught albacore sold to buyers in United States ports were not captured by the product-based system.

The pre-1951 product and landed weight data were published annually by the Canada Dominion Bureau of Statistics. Between 1939 and 1950 Canadian trollers landed between zero (1942) and 1,012 tonnes (1949) of albacore in Canada (Anonymous 1917-1950; Ware and Yamanaka 1991:Table 1).

In 1951, DFO implemented the multiple sales slips system in order to provide more accurate and timely estimates of catch and effort. Fish buyers were responsible for completing sales slips at the time fish were first sold. They recorded landings at the point of sale in weight and value; the statistical area of catch was noted. Buyers, fishers and/or processing companies were required to return sales slips to DFO personnel who compiled and published catch data by month (week for numbers of salmon) and area in annual reports (Anonymous 1952-1996). This was a definite improvement over the product-based system, but still did not capture albacore landings in US ports (only a handful of US buyers sent copies of their landing records to DFO), nor did it fully capture direct sales of albacore to the public.

Sales slip records of Canadian albacore catch between 1951 and 1994 ranged from zero (1954 and 1955) to 3,921 tonnes (1972) (Ware and Yamanaka 1991; Stocker 2005:Table 1). For 1970 to 1976, these catches included a ten percent upward adjustment of sales slip amounts based on results from a logbook program between 1972 and 1976 (Bourque and Humphreys 1973; Bourque 1974, 1975; Lockner 1977a, 1977b). This was a period during which there was high abundance of albacore off the British Columbia coast as far north as Moresby Island in the Queen Charlotte Islands.

The Canadian catch increased again starting in 1994 (1,998 tonnes), reflecting a shift in trolling effort due to a severe downturn in the salmon troll fishery. By the late-1990s, high prices for blast frozen albacore, the predominant product from the Canadian fleet, and increased restrictions on salmon fishing turned more fishers to albacore fishing. Canadians were then consistently harvesting 2,500 to 4,000 tonnes of albacore per year, much of it from the United States Exclusive Economic Zone (EEZ), as allowed under the *1981 Canada/US Albacore Treaty* between Canada and the US governing reciprocal EEZ fishing and port access for vessels jig-trolling albacore (Shaw and Argue 2000).

There was growing concern that the sales slip system was not accurately capturing the full albacore harvest by Canadian vessels. Starting in the late 1980s, two to five Canadian jig-trollers annually fished south Pacific albacore well below the equator, and by the late 1990s some 40 to 60 Canadian vessels fished albacore on the high seas in the north Pacific as far west as the dateline (Argue et al. 1999; Argue and Shaw 2000). By the late 1990s, the combined coastal and high seas Canadian albacore fleet numbered between 150 and 200 vessels each year, producing a catch worth in excess of $20 million in landed value. Much of this harvest was landed in continental US ports or in far off ports such as Papeete in French Polynesia, and Pago Pago in American Samoa. Sales slip

records from Canadian buyers by this point substantially underestimated the total Canadian catch.

When the Canadian fishery, and to a lesser degree the US fishery, intensified in the mid-1990s, Canada and the US recognized that improvements were needed to their catch and effort statistics which, under the *1981 Canada/US Albacore Treaty*, are required to be exchanged annually, a practice that had not been followed until the mid-1990s.

The database described herein is a major component of Canada's response to the need for improved annual catch statistics.

3. DATABASE MANAGEMENT SYSTEM

The *Canadian Albacore Tuna Catch and Effort Relational Database* is a database management system (DBMS) developed in Microsoft Access© by Fisheries and Oceans Canada (DFO) to relate catch and effort data by geographical area for the albacore tuna fleet from various data sources, 1995-present.

3.1. Data Sources

There are six sources of catch and effort information utilized in the database.

As a condition of licence all albacore tuna fleet vessel masters are required to:

1. Notify Canadian and USA authorities of their fishing activity by hailing out with their intention to start fishing, notifying of changing zones or canceling of trips and hailing in when fishing activity has ceased. The hail data information is used in the albacore database to estimate total vessels fishing.
2. Complete harvest logbooks at sea to be reported in hard copy to DFO. These constitute the triplog or logbook information, which give the best estimate of catch in numbers by geographical location and date.
3. Keep accurate catch records by way of fish slips to be submitted to DFO. Fish slips or saleslips supply the most accurate catch data in terms of total weight by fishing trip.

The other sources of annual catch and effort data required to complete the total annual estimates include:

4. The total annual tonnages of trans-shipments (t) of albacore that have not been identified in logbook or saleslip information, if any. These data are included in the total annual catch.
5. The total annual unreporting vessel counts, which refer to reliable estimates of vessels fishing that were not submitting catch data to DFO. These data, if any, are used in conjunction with reporting vessels to estimate the total vessel effort.
6. Documented vessel-specific annual corrections to fisher catch records that are supplemental to triplog or saleslip records. These data are used in both catch and effort calculations.

The relevant data tables and data fields for these sources are depicted in the Relationships table (Figure 1), and described below.

3.1.1. Logbooks

The principle source of catch and effort information is obtained from vessel trip logbooks ("triplogs"), which provide daily catch and effort at the highest temporal and geo-spatial resolution. All Canadian vessels must carry logbooks while fishing for highly migratory fish species, in any waters. Logbook entries include daily catch and by-catch (pieces), daily effort (hours fished, number of jigs), daily position (latitude/longitude coordinates), average weight of fish caught, and sea surface temperature. Daily estimates of mean weight are derived onboard by fishers using length-weight conversion tables (Clemens 1961).

All logbook data are recorded in the albacore database in three linked tables (Figure 1, Figure 2, Appendix Table 3.1-3.3). Vessel trip metadata (vessel captain, crew size, offload port, etc.) are captured in the *Triplog* table. Originally, fishers were encouraged to record catch data multiple times per day. Thus catch date (in table *CatchData*) was separated from actual catch at location (in table *CatchDataSets*) to permit multiple data records per date, and this structure persists to this day even though fishers are not required to record information at that level of temporal detail.

Key fields used by the database to track logbook catch and effort include:

1. *CFV#* - this refers to the Vessel Registration Number (VRN), which uniquely identifies each vessel.
2. *Trip#* - sequential trip number assigned by vessel master to identify a particular outing, from hail out to hail in and catch landed.
3. *Year* – fishing year (calendar year for northern hemisphere fleet, November to March for southern hemisphere fleet).
4. *Date* – date of fishing activity.
5. *Latitude* and *Latitude Hemisphere* – latitudinal position.
6. *Longitude* and *Longitude Hemisphere* – longitudinal position.
7. *NumberOfFish* – catch (pcs) for that date and geographical position.
8. *AvgWtOfFish* – mean weight (lbs) for the catch for that date and geographical position.

Daily total catch weight may be derived from the product of the number of fish caught and the average weight of fish.

3.1.2. Sales Slips

A secondary source of vessel catch and effort information is available from landings records ("saleslips", or "fishslips") from fish processing plants. These data are incorporated into the DFO *Catch Statistics* data management system, and made available post-season to managers, scientists, and the public. Saleslip data provide albacore catch weight estimates by vessel, trip, landing date, and albacore size class. These catch data are considered to be the most accurate estimates of albacore landings, though they do not

fully account for *international sales*, domestic *public sales* or *take-home* totals, and thus underestimate total landings by an unknown factor.

All saleslip data are recorded in the albacore database in two linked tables (Figure 1, Figure 3, Appendix Table 3.4 and 3.5). Vessel trip metadata (vessel captain, saleslip number, landing date, offload location, etc.) are captured in the *FishSlipHeader* table. Multiple landing weights may be recorded per fish slip, according to size, condition of fish, price per pound, etc., so the metadata table is linked in a one-to-many relationship to the *FishSlipData* table, where catch weights are recorded.

Key fields used by the database to track saleslip catch and effort include:

1. *CFV#* - this refers to the Vessel Registration Number (VRN), which uniquely identifies each vessel.
2. *Slip#* - unique saleslip number for landed catch.
3. *Year* and *Date* – landed catch offload date.
4. *AreaOfCatch* – geographical area where most of the fish were caught.
5. *TripNumber* – sequential trip number assigned by vessel master to identify a particular outing, from hail out to hail in and catch landed. This is not included in the saleslip information, but is added to the table later through the triplog/saleslip reconciliation process (see Section 3.3.4).
6. *SpeciesCode* – used to ensure that only albacore data are included in the analysis.
7. *Weight* – landed catch in pounds (lbs).

3.1.3. Hail Data

The hail reporting information includes vessel registration number (VRN), home port, operator/captain, and radio call sign (Stocker and Shaw 2005). Data relevant to the albacore database are stored in table *VesselFishingYears* (Figure 1, Appendix Table 3.6).

Key fields used by the database to track vessel effort include:

1. *VesselID* – uniquely identifies the vessel.
2. *CalledIn* – confirms vessel fishing activity.

3.1.4. Trans-shipment Data

Data in the *Transhipment* table consist of records of total annual albacore weights (t) offloaded en-route to or from the fishing grounds, that are not already included in logbook or saleslip data sources (Figure 1, Appendix Table 3.8). These data may come from various sources (fishers, processors, etc.) but are only included for documented transfers.

Key fields used by the database to incorporate trans-shipment weights include:

1. *Year* – tuna fishing year of trans-shipment.
2. *FAOArea* – geographical area (FAO designation) of catch.
3. *Tonnage* – Total weight in metric tonnes (t) of trans-shipment.

3.1.5. Unreported Vessels Data

The total annual unreporting vessel counts are used in conjunction with reporting vessels to estimate the total vessel effort. Key fields used by the database to incorporate trans-shipment weights include:

1. *Year* – tuna fishing year.
2. *Hemisphere* – north or south hemisphere location of vessels.
3. *UnreportedVessels* – number of vessels.

3.1.6. Supplemental Data

Retrospective corrections to fisher catch records that are supplemental to triplog or saleslip datasets are recorded in the *SupplementalCatch* table (Table 1). Key fields used by the database to incorporate trans-shipment weights include:

1. *Year* – tuna fishing year.
2. *VRN* – vessel registration number.
3. *AddToUSCatch* – weight to be included for US area catch (lbs).
4. *AddToTotalCatch* – weight to be included for total catch (lbs).

3.2. Database Development

The albacore database was developed to provide the best estimate of total annual (monthly summaries also available) catch and effort by vessel and area using disparate, and potentially duplicative, data sources. In addition, source data may be missing, incomplete, or erroneous, and, where required, must be estimated in a reasonable manner.

Post-season analyses of landings may be constrained by the unavailability of saleslip data, which are generally not accessible before March of the following year. Until saleslip data become available, albacore catch and effort estimates must be wholly based on triplog information.

The albacore relational database design rules were developed to generate estimates for catch and effort based on the above contingencies. For example, a vessel may hypothetically submit triplogs representing catch data for areas 1 and 2, while saleslips may provide landings for that vessel from areas 2 and 3 only; the best estimates of catch (weight) will be derived from triplogs for area 1, and saleslips for areas 2 and 3. The best estimates of effort (days fished or boat-days) and area fished (location) will be derived from triplogs for areas 1 and 2, and from saleslips for area 3.

The logical assembly of albacore tuna landings data is described in the *Conceptual Data Model* section of this document. The analytical techniques described in the *Physical Data Model* section are formulated to address the shortcomings in the data for the estimation of catch and effort by area.

3.2.1. Conceptual Data Model

A *conceptual data model* outlines the logical relationship of datasets, fields, and/or tables that resolve the database requirements. The solution to the principle data requirements of the albacore tuna database can be represented diagrammatically in a series of Venn diagrams based on set theory, described in this section.

Standard database query techniques can be used to classify the catch and effort data according to the Venn diagrams described below, based on the intersection of the key variables: *year*, *vessel registration number* (VRN), *trip*, and *fishing area*. The analytical processes and mathematical formulations applied to the data are described in the *Physical Data Model* section.

3.2.1.1. Catch and Effort Sources

Albacore catch estimates are based on trip logbook records and/or saleslip landings, recorded in *pounds* (lb) and converted to *metric tonnes* (t). Size classes, where distinguished on saleslip records, are pooled.

Effort is measured in *days fished*. Any date with a non-zero number of hours of fishing activity by a vessel, recorded in triplogs, constitutes a unit of effort. Non-fishing days (due to travel, inclement weather, mechanical break-down, etc.) are omitted from effort analyses.

Saleslip records distinguish between *length of trip* (days at sea, including travel to and from the fishing grounds) and *days fished*. Where corresponding triplog data is missing, saleslip *days fished* is used to define trip fishing effort.

Catch and effort are organized and summarized by "DFO fishing area". These fishing areas comprise the EEZs of Canada (BC) and the US (Washington, Oregon and California), and offshore waters inside and outside of the convention[1] area (Figures 4 and 5, Table 2). The data can be further summarized at the FAO[2] statistical area level.

Triplog catch weights for a given year-vessel-trip are derived from the daily tally of fish multiplied by the mean daily weight of albacore caught. If no mean daily weight is available, the weighted trip mean weight, or (if absent) the weighted annual area mean weight is used, where area is derived from the conversion of the daily triplog record of latitude and longitude coordinates into designated fishing areas. Albacore catch weights are then summed by vessel-trip-area to get total catch and effort by area.

Saleslip catches for a year-vessel-trip are calculated as the sum of albacore weights across size classes as recorded on the processing plant saleslip. Effort is recorded as total days fished on the trip. Since only one fishing area is assigned per tuna fish saleslip, and detailed date-specific area of catch is not recorded, catch and effort may be aggregated from multiple fishing areas on a saleslip record.

The assignment of a single fishing area to a saleslip catch record may occur at the processing plant via inquiry with the vessel owner/operator, by DFO personnel based on interview data at a later date, or by the database administrator during data compilation,

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[1] Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

[2] United Nations Food and Agricultural Organization.

based on a tally of days fished in each area, where matching triplogs exist. Clearly, saleslip records by themselves may constitute a large source of error in estimates of catch by fishing area, since the designation of trip fishing location is decided based on a simple majority (i.e., more than 50%) of days fished in an area.

In the case where saleslips and triplogs are matched by year-vessel-trip, however, saleslip total trip weights can be apportioned to individual trip dates and fishing areas based on the distribution of catch (pieces) in the logbook records. This method utilizes the most accurate weight data (from saleslips) in conjunction with the high spatial and temporal resolution of triplog data to provide the best estimate of total albacore catch by date and location.

3.2.1.2. Calculating Catch and Effort for Unique Vessels

Let A represent the total annual landed catch (weight) of albacore tuna from Canadian vessels.

Let T represent the subset of albacore catch weight data, available from triplogs, for a combination of *key variables*, such as *year*, *vessel*, *trip*, and *geographical fishing area*.

Let S represent the subset of similar data available from saleslips.

Let Z symbolize the intersection of T and S, which represents catch data where records exist from both triplog and saleslip sources with the same key variables ($Z = T \cap S$). Then X is the subset of triplog catch data for which no saleslip records exist for the key variables, and Y is the subset of saleslip catch data for which no triplog records exist. Therefore, segments $X + Y$ represent the unique contributions of catch and effort from triplog and saleslips sources, respectively. The intersection of triplog and saleslip datasets may be illustrated in a Venn diagram (Figure 6).

The set of records for total annual catch of albacore from Canadian fishing vessels can be described as:

$$A = X + Y + Z, \text{ where } Z = T \cap S \qquad (1)$$

In conceptual terms, circle T grows as triplog data are received at the end of the tuna fishing season. Before saleslip data become available post-season, circle S (and thus segment Z) are non-existent. At this preliminary stage, an estimate of the total albacore catch can be generated using triplog data only, using appropriate expansion factors based on known licensing information concerning overall fleet size.

As saleslip data are incorporated into the database, circle S grows, and segment Z expands. As the overlap of circles S and T increases, $X \rightarrow 0$, $Y \rightarrow 0$, and $Z \rightarrow T \approx S$. In other words, when triplog submission compliance is close to 100% and all saleslip data have been retrieved from DFO Catch Statistics, the *unique* contributions of triplog (X) and saleslip (Y) data go to zero, and there is a high level of redundancy between triplog data and saleslip data ($T \approx S$). This overlap can be used to cross-check and verify the data.

However, due to minor and often irreconcilable differences, the post-verification catch data for Z may not be equivalent between the two sources, nor may it be clear which value is the most accurate for a given set of key variables. For example, triplog daily weight estimates are based on length measurements and may therefore be biased by

length-weight conversion errors, while saleslip trip weight totals may underestimate trip catch where *dock sales* to the public have occurred. Thus, two estimates for total annual catch weight may be derived depending on whether saleslip or triplog weights are selected where matches occur on key variables. Procedures that eliminate the possibility of erroneous duplication of catch and effort are required regardless of which estimation method is employed.

The *triplogs-based* approach provides the preferred estimate when saleslip data are unavailable or significantly incomplete. For this method, trip catch (lbs) for segment Z is derived from the sum (across key variables year-vessel-trip) of the product of triplog daily catch (pcs) and average daily fish weight. Matching saleslip catch estimates are ignored. This estimate therefore utilizes triplog data as the best estimator where both triplog and saleslip data exist for a given year-vessel-trip, with the end result that:

$$A = T + Y, \text{ if } Z \text{ is based on triplog data } (T). \quad (2)$$

The *saleslip-based* approach provides the preferred estimate after saleslip data have been incorporated into the database. This method utilizes saleslip landing records as the best estimator of catch weight where both triplog and saleslip data exist for a given vessel-year-trip, such that:

$$A = S + X, \text{ if } Z \text{ is based on saleslip data } (S). \quad (3)$$

3.2.1.3. Reported Catch and Effort Undefined By Area

A special case of reported catch data that is undefined by fishing area arises from unmatched triplogs (X) or saleslips (Y) for which fishing area cannot be determined. The distribution of catch and effort (vessel fishing days) associated with these records can, however, be assumed to follow the geographic distribution of the overall fleet, and can therefore be distributed to area in proportion to the known catch and vessel distribution, respectively. Catch and effort from *undefined areas* can then be added to the catch and effort from *defined areas* to generate *total reported catch by area.*

3.2.1.4. Effort and Catch per Effort

Once the unique catch (lbs) and effort (days fished) information is obtained based on reported catch records, using either the *triplog-* or *saleslip-based* approach above, *effort* and *catch per unit effort* indices can be derived at the individual vessel, fishing area, and fleet-wide annual levels.

$$\textit{Days per Vessel} = \textit{Total Fishing Days} / \textit{Total Vessels} \quad (4)$$

$$\textit{Catch per Vessel} = \textit{Total Catch} / \textit{Total Vessels} \quad (5)$$

$$\textit{Catch per Day} = \textit{Total Catch} / \textit{Total Days} \quad (6)$$

These indices can be used to adjust the reported catch to account for non-reporting vessels, as described in the *Expanding the Catch and Effort* section below.

3.2.1.5. Expanding the Unique Vessels Fishing

The conceptual model above relies on information at the year-vessel-area level, and thus must be expanded to incorporate the occurrence of vessels fishing in unknown areas. The

source of such unknowns may be either vessels fishing, as indicated by hail data, for which triplogs or landings records are not available, or "ghost" vessels (observed but unidentified vessels that cannot be accounted for by hail data, vessel registration, etc.) from interview reports. To accommodate these possibilities, Circle *H* is added to the Venn diagram to represent the unique set of all Canadian vessels fishing: hailing, reporting, non-reporting, and unidentified "ghost" vessels.

The intersection of triplog, saleslip, and hail datasets may be illustrated in a Venn diagram (Figure 7).

Because most of the vessels operating in the albacore tuna fishery also submit triplogs (*T*) or saleslips (*S*), the only component of circle *H* that is of interest is the small proportion of vessels (less than 10% in recent years, see *Other Vessels* in Table 3) that did not submit either triplogs or saleslips (segment *Q*).

The difficulty with *Q* is that, because these vessels have not submitted catch information, it is not possible to know exactly where the *Q* vessels fished, or how many fish they caught. However, it may be assumed that the catch and effort of these vessels follow the geographic distribution of the catch and effort of the overall fleet. Thus, the annual *Q* vessels can be distributed across fishing areas in proportion to the distribution of reported fishing vessels, and added to the reported vessels in each area to yield an expanded estimate of vessels by area (equation 7).

Let A_V represent the total number of vessels in the Canadian tuna fleet, and let Q_V represent the total annual estimate of non-reporting vessels. Let A_{Va} represent the total number of *unique* Canadian tuna vessels fishing in area *a*, based on triplog (X_{Va}), saleslip (S_{Va}), and non-reporting (Q_{Va}, i.e., hail-ins, "ghost" vessels, etc.) information sources.

The proportion of reporting vessels fishing in area *a* can be derived from:

$$P_{Va} = (S_{Va} + X_{Va}) / (A_V - Q_V) \qquad (7)$$

The number of non-reporting vessels fishing in area *a* can then be calculated as:

$$Q_{Va} = P_{Va} * Q_V \qquad (8)$$

The expanded number of vessels fishing in area *a* can then be expressed as:

$$A_{Va} = S_{Va} + X_{Va} + Q_{Va} \qquad (9)$$

Note that, because all the vessels reporting via either triplog or saleslip sources can be uniquely identified, A_{Va} is also equivalent to the sum of T_{Va}, Y_{Va}, and Q_{Va}, since $S_{Va} + X_{Va} = T_{Va} + Y_{Va}$.

3.2.1.6. Expanding the Catch and Effort

Once the expanded number of vessels fishing in an area is calculated, reported catch and effort indices such as the *days per vessel* and *catch per day* statistics derived in the *Effort and Catch Per Effort* section above can be used to expand the area catch to provide the best estimate of total albacore catch.

Let D_{Va} represent the reported *days per vessel* in area *a*. Let C_{Da} represent the reported *catch per day* in area *a*. Let A_{Va} represent the expanded number of vessels in area *a* (equation 9), and let A_{Ca} represent the expanded albacore catch in area *a* to be estimated.

To account for the non-reporting fishing effort in area *a*, the expanded number of days fished D_{Vae} must first be computed as the product of the expanded vessels A_{Va} and the reported days per vessel D_{Va}:

$$D_{Vae} = A_{Va} * D_{Va} \quad (10)$$

The expanded albacore catch A_{Cae} for area *a* can then be estimated from the expanded days D_{Vae} and the reported catch per day C_{Da} in that area:

$$A_{Cae} = D_{Vae} * C_{Da} \quad (11)$$

Substituting, the expanded catch estimate can be expressed as the product of the expanded vessel count x days/vessel x catch/day for area *a*:

$$A_{Cae} = A_{Va} * D_{Va} * C_{Da} \quad (12)$$

3.2.1.7. Summarizing Vessels, Catch and Effort

Catch (lbs) and *effort* (fishing days), whether reported or expanded, are additive across DFO-area, FAO-area, and hemispheric geographic levels (Tables 4-5, D, E, K, L).

Miscellaneous catch estimates from other sources that are aggregated at the FAO level, such as *trans-shipment* data and *supplemental catch* data, can be combined with the expanded catch to generate a grand total annual albacore catch estimate (Tables 4-5, N).

Let A_{Ce} represent the annual grand total (expanded) albacore catch (t). It can be derived from the sum of albacore catch across DFO (or FAO) areas (A_{Cae}), plus the sum of FAO area trans-shipments (T_a) and/or supplemental catch data (S_a):

$$A_{Ce} = \Sigma (A_{Va} * D_{Va} * C_{Da}) + \Sigma (T_a) + \Sigma (S_a) \quad (13)$$

Let A_{De} represent the annual grand total (expanded) albacore fishery effort (days fished). It can be derived from the sum of boat-days (days fished) across DFO (or FAO) areas (D_{Vae}):

$$A_{De} = \Sigma (A_{Va} * D_{Va}) \quad (14)$$

Unlike catch and effort indices, the number of *unique vessels fishing* can only be determined at particular aggregate levels, as they are not additive across aggregate levels. Since a vessel cannot fish in two places at one time, but may fish in two places at different times, the derivation of unique vessels fishing depends on the specific spatial and temporal scales selected. For example, the entire Canadian tuna fleet comprises the set of unique vessels fishing in the Pacific Ocean in a given fishing season. However, over the course of the season, a vessel may fish in multiple FAO areas, contributing to the unique vessels fishing in each of those FAO areas. It would, however, be incorrect to add the unique vessel contributions from different FAO areas together, because they would no longer be unique at the larger aggregate level, and would therefore overestimate fleet size.

3.2.2. Physical Data Model

The physical data model identifies the DBMS file structure that houses the database and codebase elements, and describes the hardware and software requirements to operate the

DBMS. It also includes a definition of the data structure (data tables, fields, relationships) and an outline of the functional and analytical interface developed to allow users to analyze and interpret the albacore catch and effort data.

3.2.2.1 System Requirements

The *Canadian Albacore Tuna Catch and Effort Relational DBMS* was developed using Microsoft Access© software as a stand-alone application on Windows© (IBM© PC-compatible) computers within the DFO network. Hardware requirements include a colour monitor with a minimum resolution of 1028 x 760 pixels, and 30 Mb of free disk space.

Software requirements include MS-Access© 97 (SR-1) for Windows 98©, or later.

3.2.2.2. File Organization

The *Canadian Albacore Tuna Catch and Effort Relational Database Management System* comprises two MS-Access© database components:

- Albacore.mdb – the *codebase*, containing source code, queries, reports, lookup tables, and forms comprising the functional and analytical components of the user interface with the database. This file is often referred to as the "front-end".
- AlbacoreData.mdb – the *database* proper, which contains the database tables for triplog, saleslip, hail and vessel data, and is often referred to as the "back-end" file.

The "back-end" database tables are programmatically linked to the "front-end" codebase upon execution, such that the data in the "back-end" database are available to forms, reports, procedures, and queries in the codebase.

3.2.2.3. Database Data Structures

The "back-end" database objects consist of data tables only, and comprise the *triplog* tables, the *saleslip* tables, and the *hail* data table, all linked together via the *vessel information* table. See *Data Relationships* below for more information on logical table relations.

The *vessel information* table contains vessel-specific information (vessel name, size, owner, etc.) uniquely identified by vessel registration number (VRN), for all tuna fleet vessels registered with DFO. Vessel information is updated on an annual basis from DFO Licensing.

Triplog data are recorded by albacore tuna fishers on a daily basis during fishing trips in official *Albacore Tuna Log Books*, published by the Canadian Highly Migratory Species Foundation[3], and purchased by fishers as part of the license agreement. Data recorded on a daily basis include date, total hours fished, latitude and longitude, number of jigs used, water temperature, species, number of fish, and average weight of fish caught. By-catch species and numbers are also recorded. Trip specific information recorded on the logbook sheets include vessel name and registration number, trip number, captain, crew size, gear, days fished, offload date, offload port, offload weight and pieces, and buyer (Table 6).

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[3] Canadian Highly Migratory Species Foundation (CHMSF), 4829 Maplegrove Street, Victoria, B.C. Canada V8Y 3B9.

The *triplog* component of the database is comprised of three tables:

1. *Triplog* header table, housing trip-specific details (gear, start date, offload date, crew size, etc.) for unique combinations of year, vessel and trip number;
2. *CatchData* table, housing date-specific details (hours fished);
3. *CatchDataSets* table, housing catch, effort, location, and by-catch data for each catch event within a date.

Saleslip data are obtained from buyers by DFO for data entry of saleslip number, offload date, vessel name and registration number, price per pound and total weight by species, size class, and/or quality/condition code. Other meta-data recorded are skipper, area fished (if available), length of trip (days) and number of days fished, and buyer (Table 7).

The *sales slip* component of the database is comprised of two tables:

1. *FishslipHeader* table, housing catch landings details (e.g., date, gear, sales slip number, buyer, etc.) for unique combinations of year, vessel and trip number;
2. *FishslipData* table, housing species-specific details categorized by size-class (e.g., weight (lbs), condition).

The *hail data* table stores the vessel identification (Vessel ID) and date of hail for each vessel catalogued by the Coast Guard authority as actively fishing, on an annual basis.

A *supplemental catch* table was incorporated into the database to address discrepancies in DFO albacore catch data with respect to vessel owner's documented catch for the years 1995-2002. These supplemental catch data are based on substantiated submissions made by vessel owner/operators for the purposes of *qualification ranking* for the *limited vessel entry program*[4] initiated in 2005. The percent supplemental catch of the total annual catch is listed in Table 1.

3.2.2.4. Data Relationships

The primary data tables of the albacore database are related to each other via the *Vessel Information* table (Figure 1).

The data tables are *normalized*[5] to maximize data storage efficiency, maintain data integrity, and reduce data redundancy. For example, the saleslip data are housed in two tables: *FishSlipHeader*, containing the meta-data for each saleslip (vessel VRN, landing date, saleslip number, etc.), which is linked in a one-to-many relationship with table *FishSlipData*, which contains the catch (weight) by species data. Similarly, table *Triplog* contains vessel logbook meta-data for each tuna fishing trip (e.g., vessel VRN, trip

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[4] The *limited vessel entry* program was implemented in accordance with international agreements to reduce annual albacore tuna fishing effort in U.S. waters beginning in the 2005 season. Vessels eligible for fishing in U.S. waters were determined from a weighted rank analysis of annual albacore landings from U.S. waters from 1995-2002.

[5] Database *normalization* refers to the process of designing the database to minimize redundancy while maximizing the flexibility required to provide the necessary management reports and to support *ad hoc* requests which have not been pre-defined. Where practical, the database is normalized to the *3rd normal form*, meaning that tables are organized such that: [1] redundant data and calculated fields are eliminated; [2] secondary attributes are uniquely identified by the full primary key attributes; and [3] secondary attributes that depend on other secondary attributes are eliminated.

number, gear type, etc.), which is linked to daily catch event meta-data (date, hours fished) in table *CatchData*, which is itself linked to catch event data (location, number of fish caught, average weight, etc.) in table *CatchDataSets*.

These data structures are further detailed (e.g., field names, data types, primary keys, validation rules, etc.) in Appendix 3.

3.2.2.5. Codebase Objects

The "front-end" codebase objects consist of the queries, forms, reports, "look-up" tables and visual basic source code comprising the "user-interface" that enables the user to view, analyze, and interpret the data. The codebase is where all data analysis occurs. The user-interface is loaded automatically upon start-up of the codebase, and consists of a main form that provides links to sub-forms for the purposes of data entry, error-checking, data analysis, and report generation. Import and export utilities provide a means of communicating with external data sources.

Forms and reports are primarily based on queries, which ultimately reference the data in the linked database tables and look-up tables. The sequential flow that links tables and queries in an analytical sequence to arrive at the annual reported and expanded catch and effort estimates is described in the *Codebase Analysis* section below.

Look-up tables reside in the codebase and pertain to reference information, such as species codes, gear codes, and area codes, that do not change on a frequent basis. Look-up tables and their contents are listed in Appendix 4.

For more information on the design and use of the front-end codebase, see the *Albacore Tuna Catch and Effort Database User's Guide* (Stiff in prep.).

3.3. Data Entry, Editing, Validation and Quality Control

Data entry, modification, viewing, and verification are performed through forms built into the user-interface. Validation rules are programmed into data entry fields to eliminate gross errors in data entry. Drop-down "combo-box" fields are employed in data selection fields to minimize typing and reduce errors. FAO and DFO-areas are applied automatically based on latitude and longitude data entry. Calculated fields and summary statistics for numbers of fish and catch weight are displayed in the forms where appropriate to eliminate unnecessary data entry and to provide verification of data entered.

Verification and validation procedures involve summary reports of descriptive statistics, distribution plots for size and location data for outlier analyses, and reconciliation procedures between saleslip, triplog, and hail data records.

3.3.1. Triplogs

Triplog data are processed in the *Triplog* data form, which allows data entry and updating of trip information for all three triplog data tables on one screen, including trip meta-data (vessel registration number, trip number, offload date, etc.), daily catch meta-data (date, hours fished), and catch event data (number of fish, average weight, etc.). See Figure 2 and Table 6 for more logbook data entry details.

3.3.2. Saleslips

The majority of saleslips for Canadian tuna fishery operations are submitted to DFO by seafood processors on an annual basis, under agreements between the companies and DFO. These data are keypunched (and verified) by DFO in-season into the *Fishslips* data form, which provides data entry capabilities for slip information for both saleslip meta-data (vessel registration number, trip number, landing date, etc.), and species data (size class, total landed weight, etc.). See Figure 3 and Table 7 for more saleslip data entry details. Further verification and error analysis for saleslip data are performed during the process of data reconciliation with triplog data (see Section 3.3.4).

3.3.3. Hails

Hail data are retrieved from DFO Coast Guard logs which are used to document the involvement of Canadian fishing vessels in the albacore tuna fishery, including the movement between Canadian and U.S. fishing zones. The hail data are retrieved in spreadsheet format, which is imported into the Albacore Catch and Effort Relational Database, where the data are sorted and filtered for unique annual vessel entries.

3.3.4. Data Reconciliation

The post-season reconciliation process serves to match saleslip and triplog records by year, vessel, and trip. This is required because saleslip records may not be identified by trip number. Discrepancies in fishing location and catch weights must also be resolved.

A program utility displays all triplog and saleslip data available for a given vessel. By comparing triplog start and end dates with saleslip record landing dates the user can assign trip number to saleslip records. In the case where saleslip records are missing trip information, but no corresponding trip exists in the triplog data, an arbitrary trip number (e.g., 99) must be assigned to distinguish between the saleslip trip records.

It is important to also examine daily fishing area information from the triplogs to ensure that the matching saleslip record is assigned an appropriate fishing area (generally the fishing area with the majority of dates fished in the triplog data) to ensure that the match-merge process on vessel-trip-area is enabled.

Discrepancies in triplog and saleslip catch weights that are not attributable to errors in triplog daily average fish weight or triplog catch (pcs) (verified against the hardcopy logbook data), may be resolved by omitting the saleslip record from analysis, in cases where the saleslip landed weight is obviously underestimating catch. This may be the case where *dock sales* or *take-home* catches are a significant factor, and becomes apparent when the two weight estimates are divided by the logbook verified catch in pieces. Average saleslip fish weights of less than 10 lbs are a good indicator that the saleslip data are not fully accounting for the catch provided there are no obvious errors in daily triplog catch numbers, and the saleslip record should be omitted from analysis.

4. DATA ANALYSIS

As indicated above, the objective of the DBMS is to provide an annual[6] estimate of the reported catch and effort by FAO and DFO geographical areas, and to expand upon those estimates where necessary to accommodate missing elements of the Canadian albacore tuna fishery. By way of example, the compilation of catch and effort for 1998 is reported in Table 4 for the *triplog-based* ($T + Y$) analysis, and Table 5 for the *saleslip-based* ($S + X$) analysis.

4.1. Reported Catch and Effort

The general sequence of analysis begins with a synthesis of annual reported triplog and saleslip data to identify unique contributions to catch and effort from those sources (Tables 4-5 A). Where both triplog and saleslip information exist for key variables, precedence is given to the triplog information for preliminary analyses (Table 4) and to the saleslip information for the final analysis (Table 5). The total reported catch, days fished, and unique number of vessels fishing are designated by hemisphere and area (Tables 4-5 B, C). Note that the number of unique vessels by area (in B & C) do not sum up to the total number of unique vessels fishing (A), because a vessel may fish in more than one area within a fishing season. However, both the catch and days fished by area are additive and equal to the total reported catch weight and days fished.

The reported catch may be segregated into geographically-defined areas (D), and undefined areas (E) for which geographical details are not available for the catch and effort information. The undefined area catches, the number of vessels fishing, and the number of days fished are geographically apportioned, assuming the distribution of catch and effort for undefined areas will follow the distributions for defined area catches.

The area-specific fishing days per boat is calculated from the total reported days fishing divided by the number of boats in the area (F). From this, the principle indicator of effort, catch per day (G), is then based on the total area-specific reported catch divided by the area-specific fishing days per boat.

4.2. Expanded Catch and Effort

If unreported fishing effort is known to exist, then the total catch estimates can be extrapolated based on the estimated number of the unreported vessels times the reported days per vessel and catch per day indices. Counts for vessels hailing without submitting triplog or saleslip data (Tables 4-5, H), and "ghost" vessel estimates obtained from interview data (I), are allocated to fishing areas based on the distribution of reporting vessels for defined areas (D). The total "expanded" vessels (J) by area is then calculated as the sum of the reported vessels plus unaccounted "hail" vessels (H) plus "ghost" vessels (I). Multiplying the expanded vessel count (J) by the days per vessel yields expanded days fished (K). This in turn is combined with catch per day to produce expanded catch weight (L).

The expanded values for days fished and catch can be summed across DFO areas to provide total estimates for FAO areas, which, when converted to tonnes, can be added to

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[6] Monthly catch and effort analyses are also available.

trans-shipment totals (M) to estimate total expanded catch by FAO area. Total catch across FAO areas and hemispheres (north and south) yields the total expanded catch in tonnes (Tables 4-5, N). Some rounding error may be evident in the grand total.

Annual expanded catch estimate summary reports (1995-2005) can be found in Appendix 2. Estimates of expanded albacore tuna catch by Canadian fishers (Figure 8) show an increasing trend for the years 1995-2004, followed by a drop in catch in response to the introduction of the limited vessel entry program in 2005.

4.3. Reporting Details

The analytical flow that links tables and queries for the estimation of *annual reported and expanded catch and effort estimates* (Tables 4-5) can be compartmentalized as follows:

a) Calculation of total reported catch (pcs, lbs) and effort (jigs, hours, days fished) by vessel-area from triplog data (circle *T*). Albacore catch weight is calculated by vessel, trip, and date by multiplying the daily total number of fish by the average weight of fish for that vessel, trip, and date. If the average weight is missing, then the weighted mean weight of albacore for that trip is applied, or (if absent), the weighted mean weight of albacore caught in that area is applied. Although for the purposes of this analysis, fishing effort is based on vessel-days, other effort indices such as hours fished, number of jigs, and jig-hours, are also calculated. Total catch and effort indices are compiled by vessel and area in an intermediate table for input to other components of the analysis. See Figures 9a-b for a flowchart documenting triplog data compilation and query execution.

b) Calculation of total reported catch (lbs) and effort (days fished) by vessel-area from saleslip data (circle *S*) (Figures 10a-b). Saleslip data are filtered for albacore species, and the catch weight is summed by trip across size class and fish condition codes. For effort calculations, the number of days fished is used, or (if absent), an estimate of days fished based on length of trip and the ratio of trip length to days fished for the vessel, or (if absent) the fleet, is used. Triplog data, if available for this vessel and area, are merged in for calculation of other catch effort estimates, such as catch per jig hour – however these CPUE indices are currently not employed in any further calculations. Total catch and effort indices are compiled by vessel and area in an intermediate table for input to other components of the analysis.

c) Calculation of unique vessels fishing by area based on triplog and saleslip sources (Figures 11a-b). Compare and contrast unique vessel list from triplog and saleslip sources, and compile total number of unique vessels by hemisphere for input to other components of the analysis.

d) Calculation of unique unreported vessels based on intersection of hail dataset in circle *H*, triplog dataset circle *T*, and saleslip dataset circle *S* (Figures 12a-b). Get list of vessels that have hailed but not submitted catch data (segment *Q*). Store count of *Q* vessels in an intermediate table for input to other components of the analysis.

e) Calculation of expanded catch (t) and effort (days fished) based on *saleslip-based* ($S + X$) analysis (circle *S*, segment *X*, and segment *Q*, by area and hemisphere

(Figures 13a-b)). Combine unique year-vessel-trip catch and effort summaries from triplog and saleslip sources (a and b, above), such that total reported catch by vessel for defined areas is based on saleslip catch (circle *S*) plus unmatched triplog catch from segment *X*. Calculate proportion of unique vessels and reported catch by DFO area for defined areas. Use proportions to distribute undefined area catch and days fished data. Calculate area-specific days-per-vessel and catch-per-day statistics based on reported data. Use vessel distribution for defined areas to distribute unreported vessels (hail-ins and "ghost" vessels) to DFO area. Sum reported and unreported vessels to get "expanded" total vessels by area. Use expanded vessels with reported days-per-vessel and catch-per-day to generate expanded catch by DFO area. Summarize by FAO area, convert to tonnes, and incorporate supplemental and trans-shipment tonnage (if any) for estimate of total annual catch (expanded).

f) Calculation of expanded catch (t) and effort (days fished) based on *triplog-based* (*T* + *Y*) analysis (circle *T*, segment *Y*, and segment *Q*, by area and hemisphere (Figures 14a-b)). Combine unique vessel-trip-area catch and effort summaries from triplog and saleslip sources (a and b, above), such that total reported catch by vessel for defined areas is based on triplog catch (circle *T*) plus saleslip catch from segment *Y*. Calculate proportion of unique vessels and reported catch by DFO area for defined areas. Use proportions to distribute undefined area catch and days fished data. Calculate area-specific days-per-vessel and catch-per-day statistics based on reported data. Use vessel distribution for defined areas to distribute unreported vessels (hail-ins and "ghost" vessels) to DFO area. Sum reported and unreported vessels to get "expanded" total vessels by area. Use expanded vessels with reported days-per-vessel and catch-per-day to generate expanded catch by DFO area. Summarize by FAO area, convert to tonnes, and incorporate supplemental and trans-shipment tonnage (if any) for estimate of total annual catch (expanded).

g) The *triplog-based* (*T* + *Y*) analysis (f, above) applies also to monthly summaries. See Table 8 for a monthly summary report.

4.4. Catch and Effort Spatial Analysis for Export to GIS

Albacore catch and effort data from triplog sources can be summarized for export to Geographic Information System (GIS) software for further analysis and plotting. Triplog catch is summarized by year, vessel, trip, and date at latitude/longitude coordinates adjusted to identify lat-long cell midpoints. The adjustment involves converting the standard lat-longs to decimal lat-longs by removing minutes and seconds from the coordinates (integerizing) and adding 0.5. Decimal longitudes greater than 180 are adjusted down to 179.5. The individual year-vessel-trip-date catch and effort records are merged with summaries of annual total catch, effort (vessels), and catch per vessel estimates. Grouping and label fields necessary are set up for GIS program purposes. The resulting query can be exported to Excel for upload into the GIS program, or summarized at the month and lat-long level for export to U.S. tuna fisheries authorities. See Figures 15a-b for a flowchart documenting lat-long data compilation and query execution.

5. DISCUSSION

5.1. Post-season and In-season Analyses

Although this database management system was originally developed as a post-season summary tool for the albacore fishery, it may also be used in-season based on its ability to forecast fleet catch based on (a) *reported catch* for a subset of the vessels, and (b) *expansion factors* associated with known fleet size and reported catch per unit effort. Assuming representative reporting of *days fished per vessel trip* and *catch per day* in the early months of the season, the program can forecast reasonable total catch estimates (expanded) based on as little as 30-40% of the vessels reporting (Figure 16). Accuracy improves as the proportion of *vessels reporting* asymptotically approaches 100%.

However, since saleslip data are not available until post-season, the in-season estimates must rely almost entirely on triplog-based information ($T+Y$ method), which raises the question of the reliability of triplog catch data vs. saleslip records. Effort estimates (*unique vessels fishing*, and *days fished* by area) are the same for each estimation method, however catch weight estimates may vary between the two approaches. To examine this issue, regression analyses were performed treating saleslip and triplog catch weight data matched by year, vessel, and trip as independent estimates of catch weight.

5.2. Comparison of Estimates

Catch estimates by year, vessel, and trip are highly correlated between saleslip and triplogs (Table 9, Figure 17). Correlations (r^2) range from 0.99 in recent years (1998-2005) to a low of 0.95 in 1995-1996.

Triplog data *overestimated* saleslip catch weights by 1% on average. Significant overestimates occurred in 1997 (15%), 1999-2000 (5%), and 2001-2003 (1-2%). Triplog data significantly *underestimated* saleslip catch weights in 1995 (11%) and 2005 (6%).

It is no surprise that post-season (final) estimates from triplog-based ($T+Y$) and saleslip-based ($S+X$) are highly correlated (Figure 18); the data are not independent at that stage in the season. However the relationship does suggest that triplog data overestimate saleslip catch weights by a mere 1% on average, which indicates that triplog data are a reasonable substitute for saleslip-based estimates of albacore landing weights.

5.3. Addressing Potential Sources of Error

Some of the potential sources of error mentioned above may be remedied simply via raised awareness in vessel operators concerning data quality, or via management directives aimed at securing more detailed information from fish processing facilities.

For example, saleslip records are considered the most accurate estimate of landed fish weight for a trip. However, these pooled trip totals cannot be readily assigned to geographical area or date. Fishers could be encouraged to include saleslip data when submitting trip logbook information to DFO. Saleslip data could be annotated with trip information (trip number) to facilitate post-season data reconciliation processes.

Limitations in the triplog dataset pertain to logbook availability. Prior to 2003, triplog data submission to DFO was voluntary, ranging from 13% of vessels fishing in 1994, to over 90% in recent years (Table 3). Since 2003, albacore tuna fishers have been required

to submit a copy of their triplogs to DFO at the end of the fishing season (November 30th) as part of the fishing license agreement. In recent years, compliance has been above 95%.

A source of bias in saleslip weight estimates involves *public sales* or *take-home* totals, which are neither captured on saleslips nor uniquely identified in triplog data. This source of bias is potentially significant because the bias always occurs in one direction, resulting in an underestimate of total landings when catch estimates are based principally on saleslip data (*S+X* method). Furthermore, when matched with total pieces caught from triplogs saleslip weights,– biased low – will overestimate average fish size. This data issue could be reconciled by educating fishers on the importance of these data to the management of the albacore tuna fishery.

Errors in allocating saleslip catch to fishing area may also be incurred due to the difficulty of partitioning aggregated saleslip data for catch from multiple geographical areas. For this reason, geographical area of catch is specified from the logbook information for the corresponding trip wherever reconciliation of the two sources of data is possible. In lieu of logbook data, catch area for a saleslip data will be assigned based on relevant information on the saleslip.

6. ACKNOWLEDGEMENTS

Thanks to Lisa Mijacika and Cory Paterson for information on the management of albacore tuna fisheries in recent years, and to Laili Aamar, Meghan Bowes, and Sheila Malcolmson for astute data entry and triplog and saleslip data reconciliation efforts.

Lorne Clayton of the *Canadian Highly Migratory Species Foundation* (CHMSF) managed the distribution and retrieval process for tuna logbooks in recent years. Sam Boehner (Archipelago Marine Research, Inc.) assisted with triplog data collection. Thanks also go to the Canadian fishing vessel operators for submitting logbook data on a timely basis; to the Canadian and U.S. fish processors for the timely provision of saleslip records; and to the DFO catch statistics group for assisting in saleslip data recovery and reconciliation.

We are grateful to Jon Schnute and Jake Schweigert from DFO for reviewing the manuscript. Their constructive comments on the analysis and content have greatly aided the comprehensibility of this report.

7. LITERATURE CITED

Anonymous. 1917-1950. *Annual Reports of the Fisheries Statistics of Canada.* Government of Canada, Dominion Bureau of Statistics.

Anonymous. 1952-1996. *British Columbia catch statistics: by species, gear, month and area.* Canada Department of Fisheries and Oceans.

Argue, A.W., and Shepard, M.P. 2005. *Historical commercial catch statistics for Pacific salmon (Oncorhynchus spp.) in British Columbia, 1828 to 1950.* Can. Tech. Rep. Fish. Aquat. Sci. 2601: 595 pp.

Argue, A.W., and Shaw, W. 2000. *An update for Canadian tuna fisheries in the north and south Pacific Ocean.* 17 pp. Document submitted by DFO to the Thirteenth Meeting of the Standing Committee on Tuna and Billfish in Noumea, New Caledonia, July 5-12, 2000.

Argue, A.W., Shaw, W., and Williscroft, N. 1999. *An update for Canadian albacore fisheries in the north and south Pacific Ocean.* 8 pp. Document submitted by DFO to the Twelfth Meeting of the Standing Committee on Tuna and Billfish in Tahiti, French Polynesia, June 16-23, 1999.

Bourque, S.C. 1974. *Status of the 1973 British Columbia albacore fishery.* Environment Canada, Fisheries and Marine Service, Southern Operations Branch Pacific Region. Technical Report Series No. PAC/T-74-3. 61 pp.

Bourque, S.C. 1975. *Status of the 1974 British Columbia albacore fishery.* Environment Canada, Fisheries and Marine Service, Southern Operations Branch Pacific Region. Technical Report Series No. PAC/T-75-10. 75 pp.

Bourque, S.C. and R.D. Humphreys. 1973. *Status of the 1972 British Columbia albacore fishery.* Environment Canada, Fisheries and Marine Service, Pacific Region. Technical Report 1973-3. 62 pp.

Clemens, H.B. 1961. *The migration, age, and growth of Pacific albacore* (*Thunnus germo*), 1951-1958. Fish Bull. Calif. Dept. Fish and Game 115: 128 pp.

Joseph, J, Klawe, W., and Murphy, P. 1988. *Tuna and billfish – fish without a country.* Inter-American Tropical Tuna Commission, La Jolla CA. 69 pp.

Lockner, B.J. 1977a. *Status of the 1976 British Columbia albacore fishery.* Fisheries and Environment Canada, Field Services Directorate Pacific Region. Technical Report Series No. PAC/T-77-9. 30 pp.

Lockner, B.J. 1977b. *Status of the 1975 British Columbia albacore fishery.* Environment Canada, Fisheries and Marine Service, Southern Operations Branch Pacific Region. Technical Report Series No. PAC/T-77-1. 26 pp.

Shaw, W., and Argue, A.W. 2000. *The 1999 Canadian north Pacific albacore troll fishery.* Document submitted by DFO to the Seventeenth Meeting of the North Pacific Albacore Workshop, Taipei, Taiwan, December 6-13, 2000. NPALB/00/04:17 pp.

Stiff, H. (in prep). *Albacore Tuna Catch and Effort Database User's Guide.*

Stocker, M. (Ed). 2005. *Report of the Nineteenth North Pacific Albacore Workshop.* Nanaimo, B.C., Canada, November 25-December 2, 2004. Fisheries and Oceans Canada, Pacific Biological Station. 127 pp.

Stocker, M., and Shaw, B. 2005. *Canadian albacore tuna fisheries in the north and south Pacific Ocean in 2004.* WCPFC-SC1 FR WP-4, Noumea, New Caledonia. 6 pp.

Ware, D.M., and Yamanaka, K.L. 1991. *Catch statistics for the Canadian albacore tuna fishery: 1945-1990.* 4 pp. Document submitted by DFO to the Annual Meeting of the International North Pacific Fisheries Commission, Tokyo, Japan, November 1991.

8. FIGURES

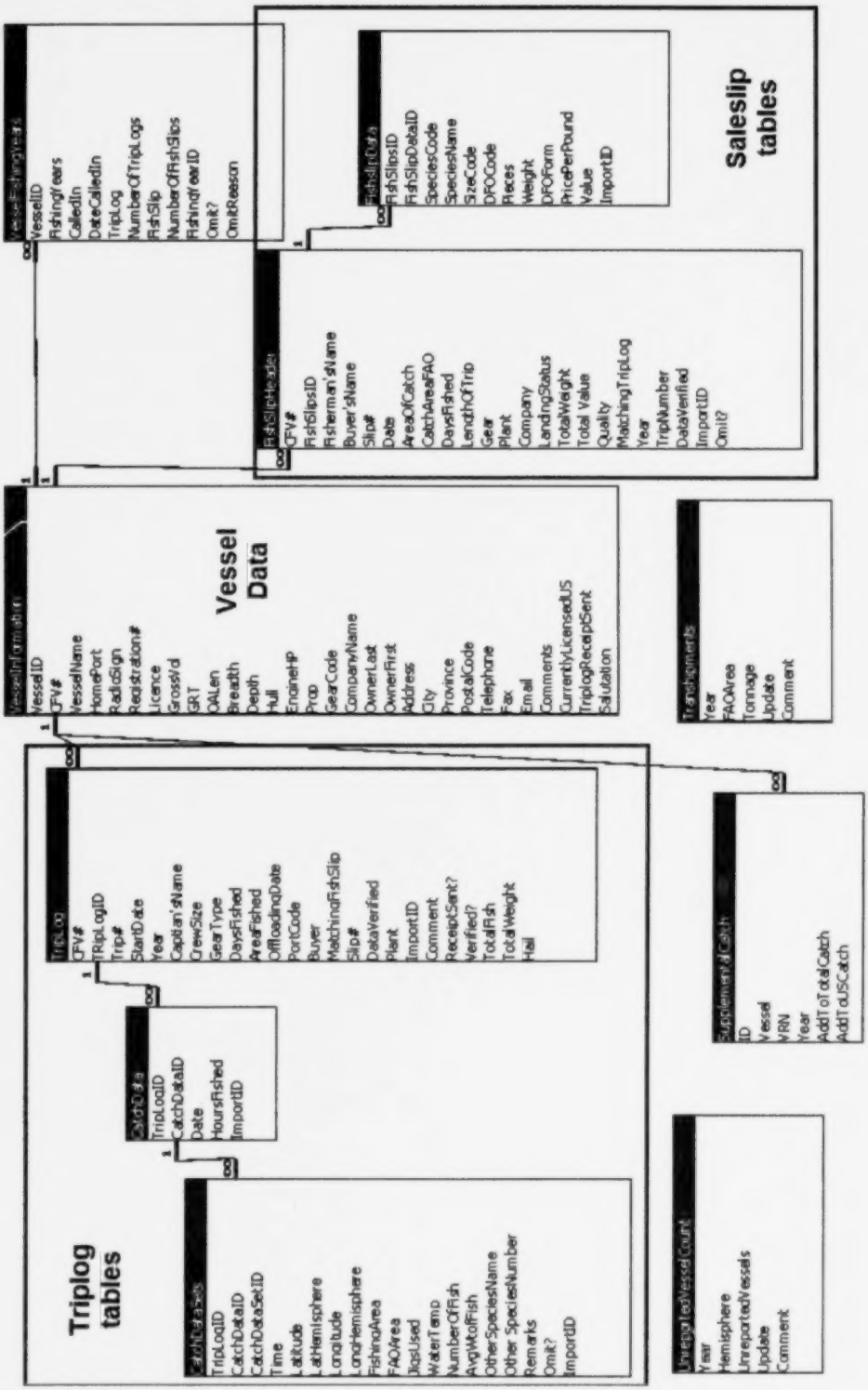


Figure 1. Albacore tuna catch and effort relational database diagram.

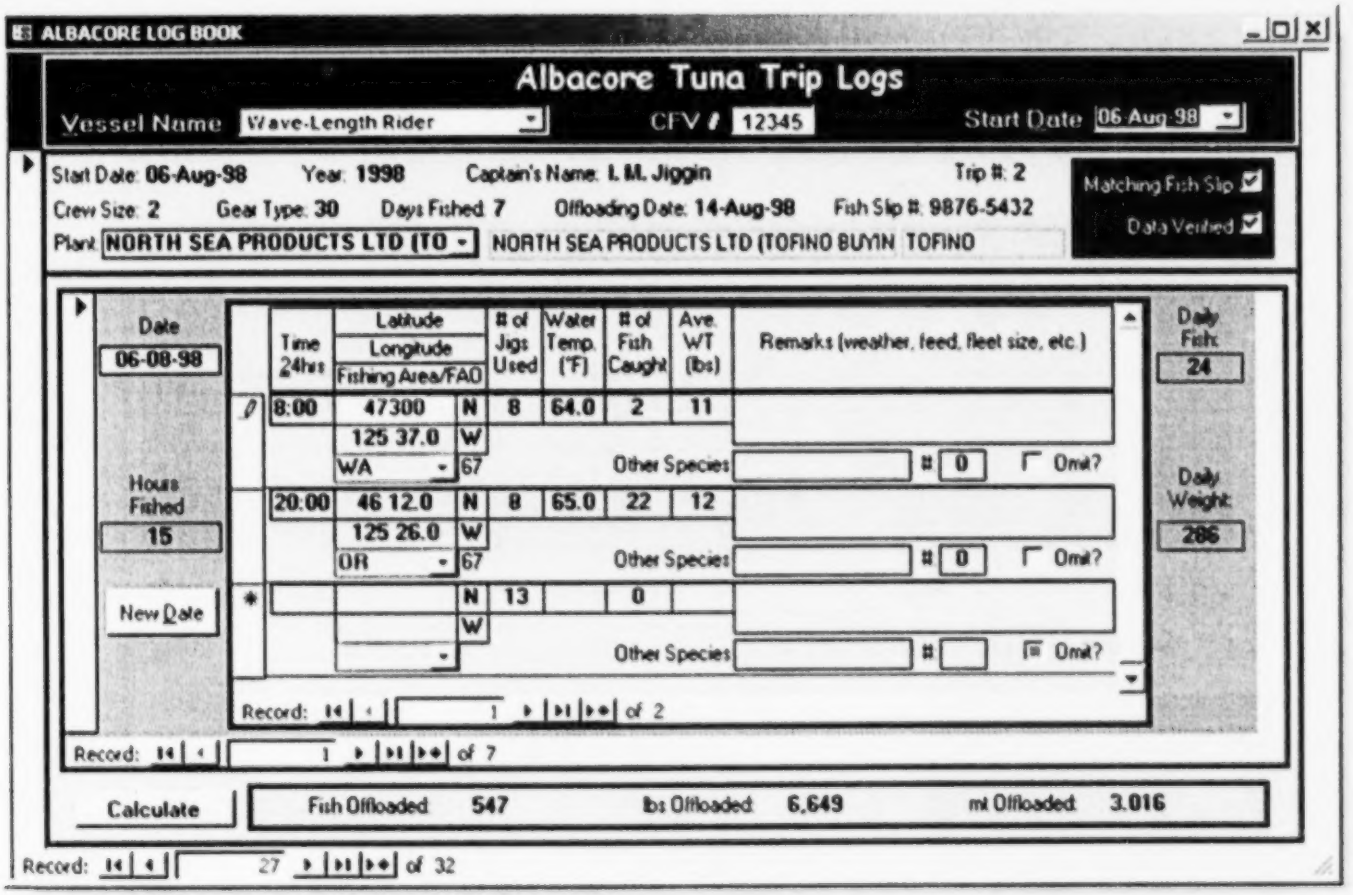


Figure 2. Triplog data entry form.

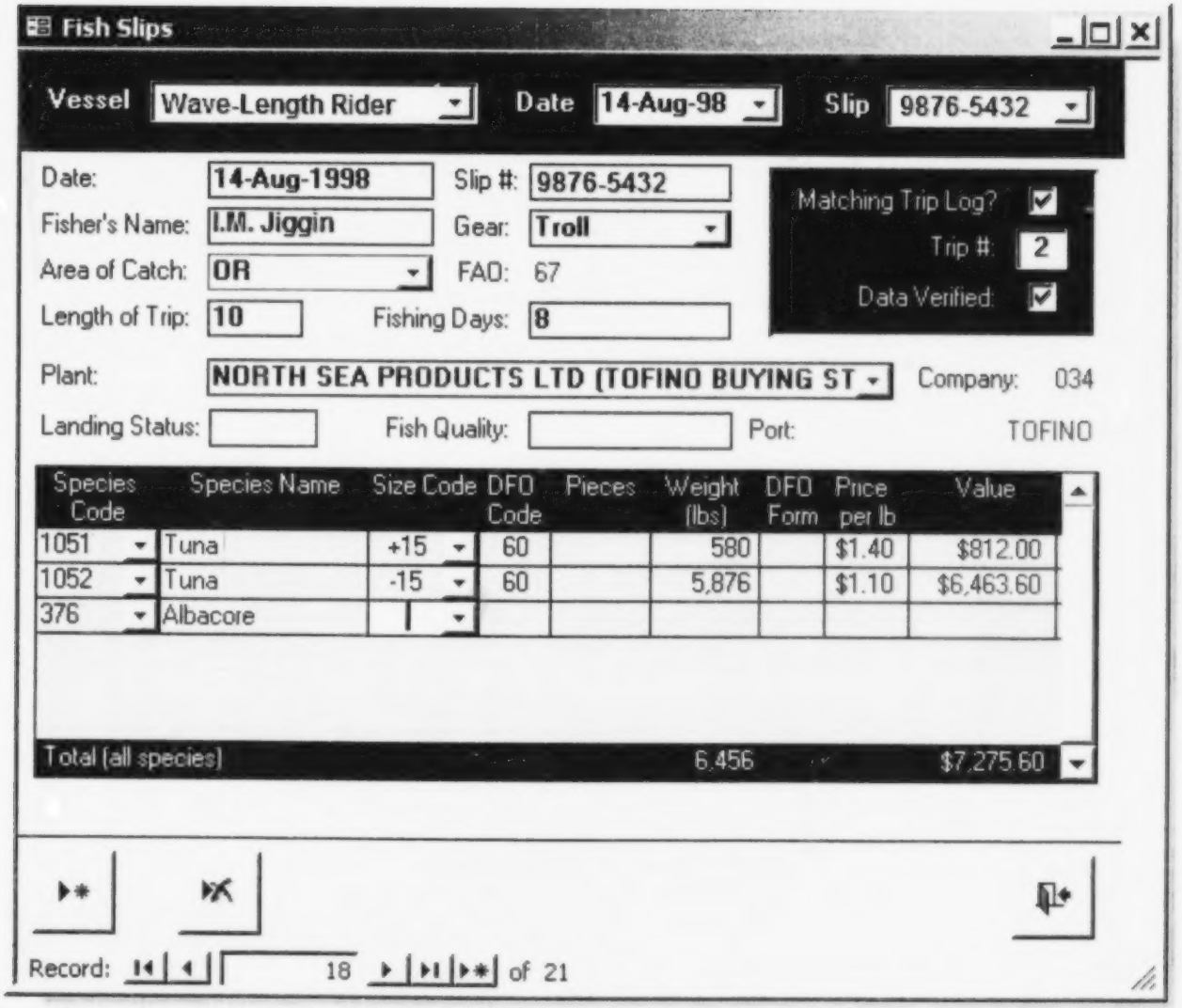


Figure 3. Saleslip data entry form.

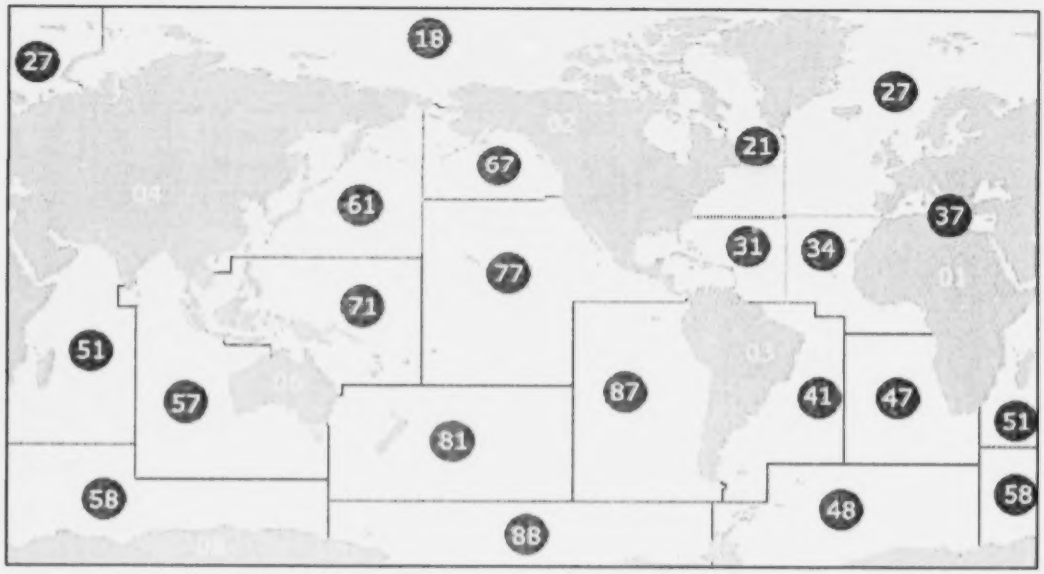


Figure 4. Food and Agricultural Organization (FAO) fishing areas.

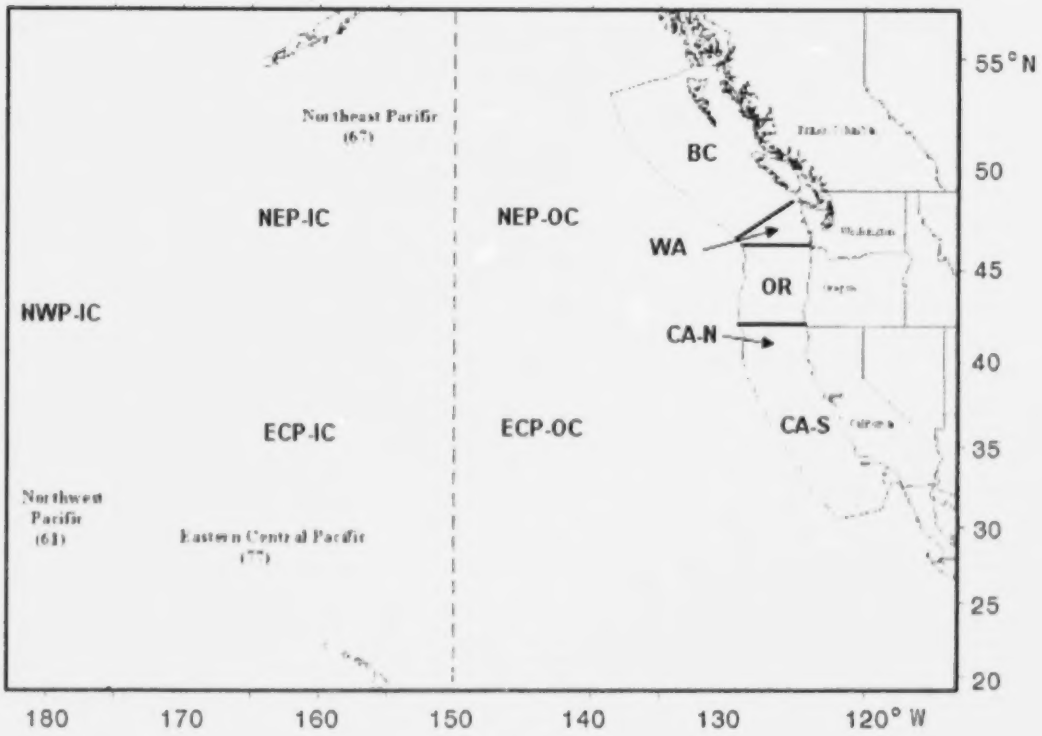


Figure 5. DFO Albacore Tuna Fishing Areas within the FAO fishing areas.

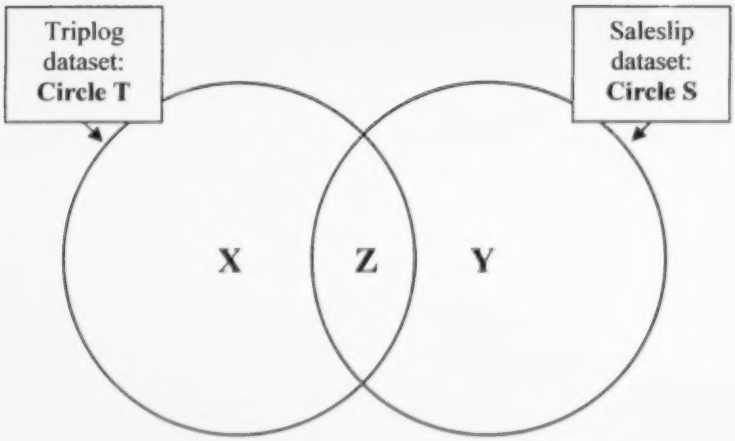


Figure 6. Venn diagram demonstrating the intersection of fisher logbook (triplogs) and landed catch (saleslip) data subsets.

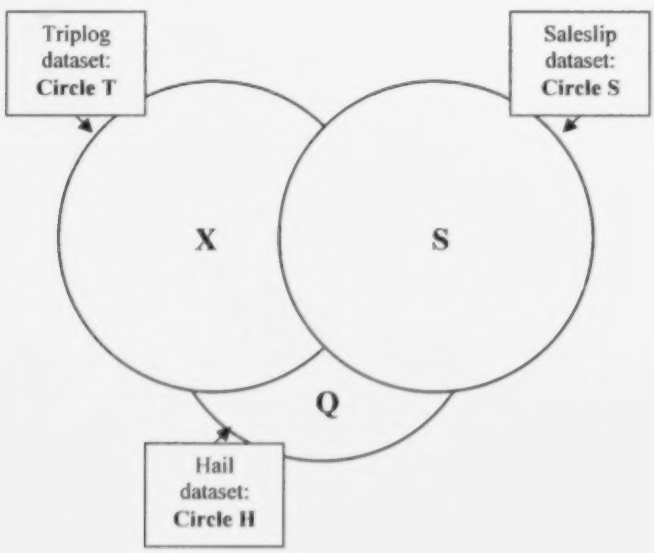


Figure 7. Expanded Venn diagram demonstrating the intersection of fisher logbook (triplogs) and landed catch (saleslip), and hail data subsets.

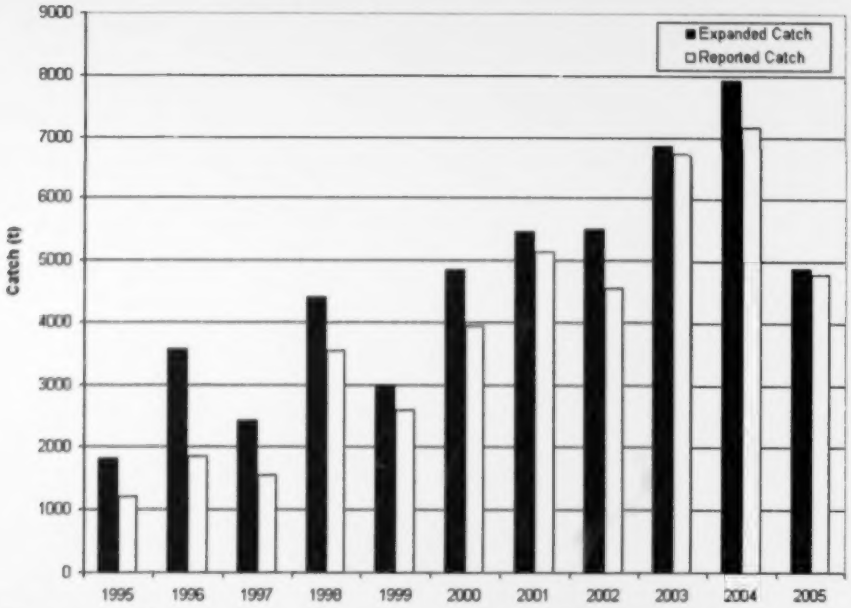


Figure 8. Albacore tuna catch estimates, 1995-2005.

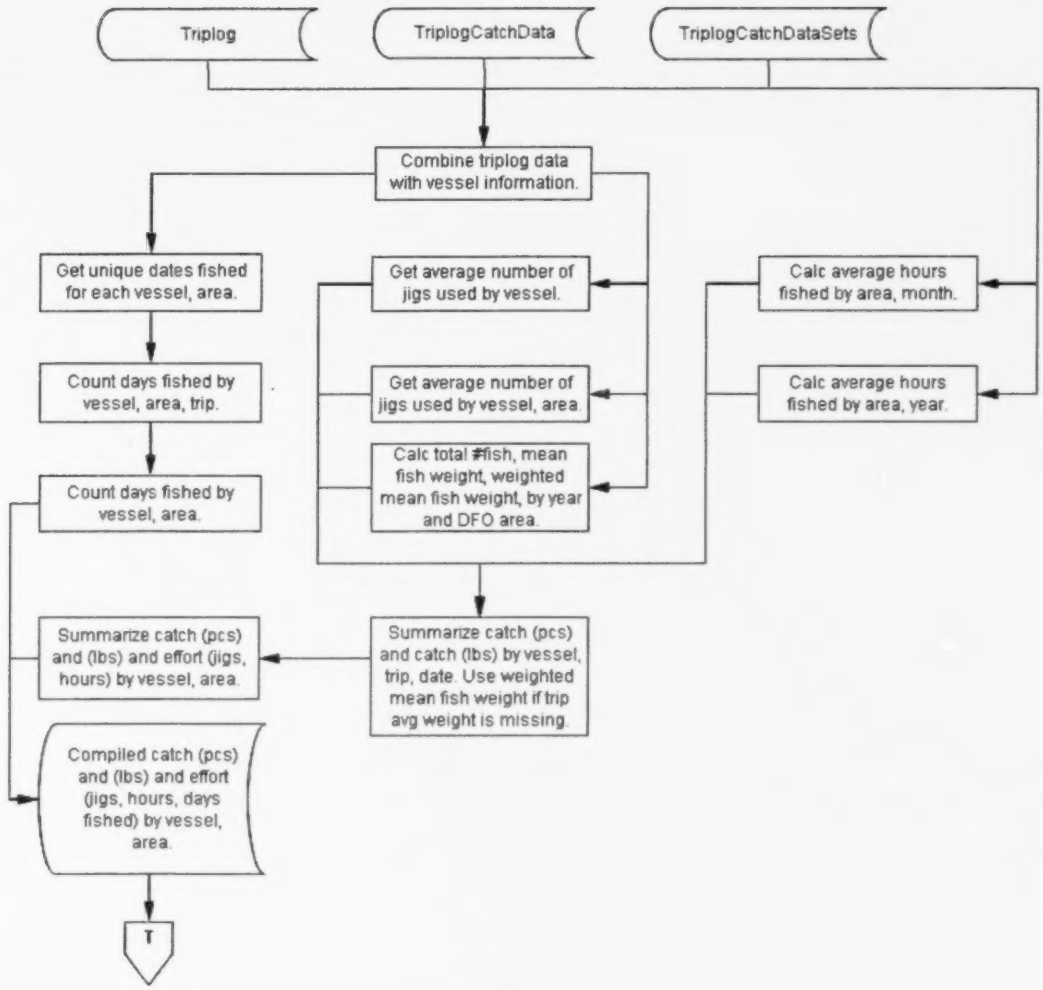

Triplog
TriplogCatchData
TriplogCatchDataSets
Combine triplog data with vessel information.
Get unique dates fished for each vessel, area.
Get average number of jigs used by vessel.
Calc average hours fished by area, month.
Count days fished by vessel, area, trip.
Get average number of jigs used by vessel, area.
Calc average hours fished by area, year.
Count days fished by vessel, area.
Calc total #fish, mean fish weight, weighted mean fish weight, by year and DFO area.
Summarize catch (pcs) and (lbs) and effort (jigs, hours) by vessel, area.
Summarize catch (pcs) and catch (lbs) by vessel, trip, date. Use weighted mean fish weight if trip avg weight is missing.
Compiled catch (pcs) and (lbs) and effort (jigs, hours, days fished) by vessel, area.
T

Figure 9a. Triplog data analytical flow model: pseudo-code.

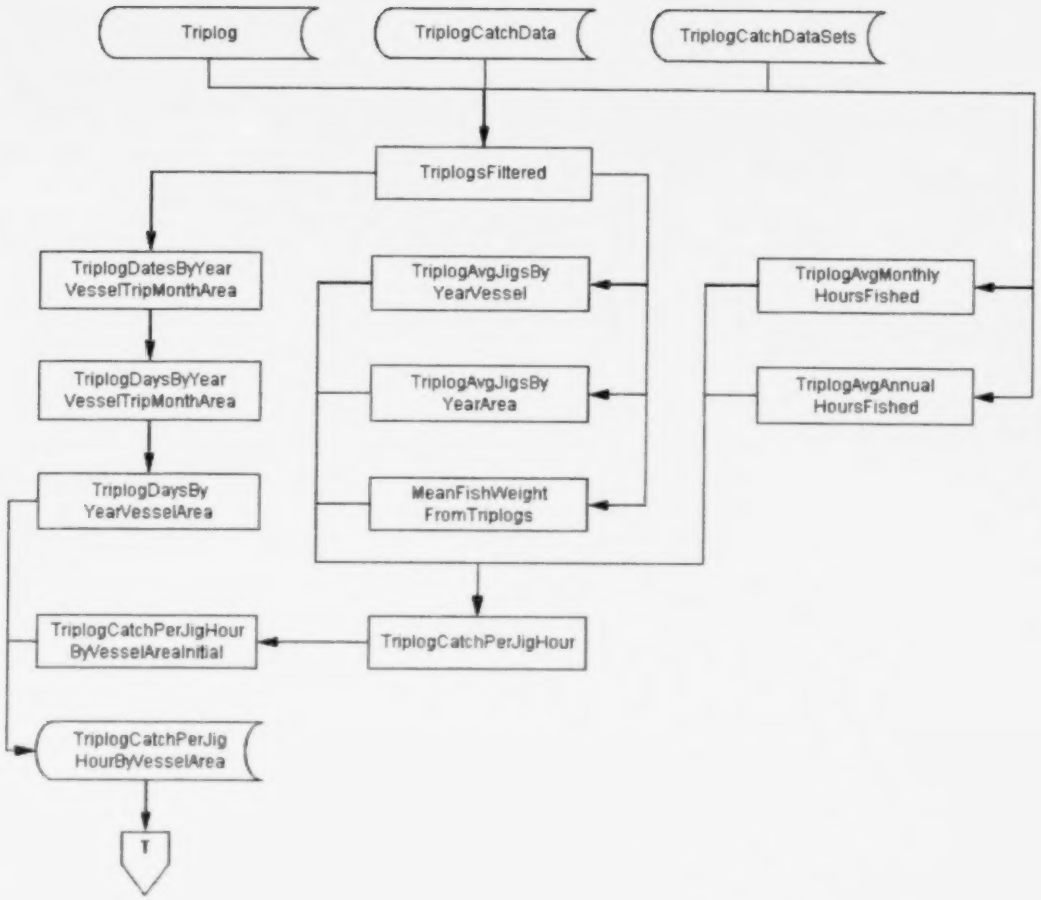


Figure 9b. Triplog data analytical flow model: database objects.

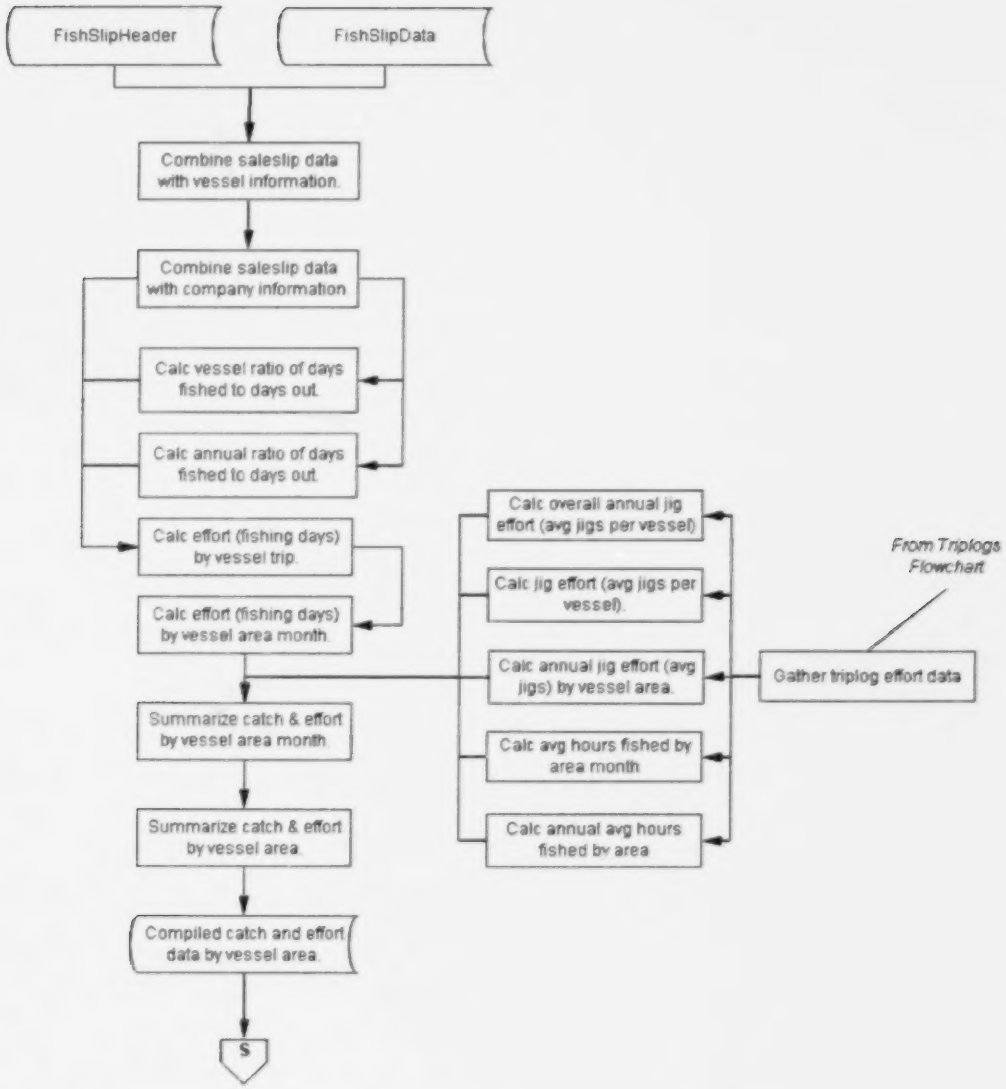

FishSlipHeader
FishSlipData
Combine saleslip data with vessel information.
Combine saleslip data with company information.
Calc vessel ratio of days fished to days out.
Calc annual ratio of days fished to days out.
Calc effort (fishing days) by vessel trip.
Calc effort (fishing days) by vessel area month.
Summarize catch & effort by vessel area month.
Summarize catch & effort by vessel area.
Compiled catch and effort data by vessel area.
S
Calc overall annual jig effort (avg jigs per vessel).
Calc jig effort (avg jigs per vessel).
Calc annual jig effort (avg jigs) by vessel area.
Calc avg hours fished by area month.
Calc annual avg hours fished by area.
From Triplogs Flowchart
Gather triplog effort data

Figure 10a. Saleslips analytical flow model: pseudo-code.

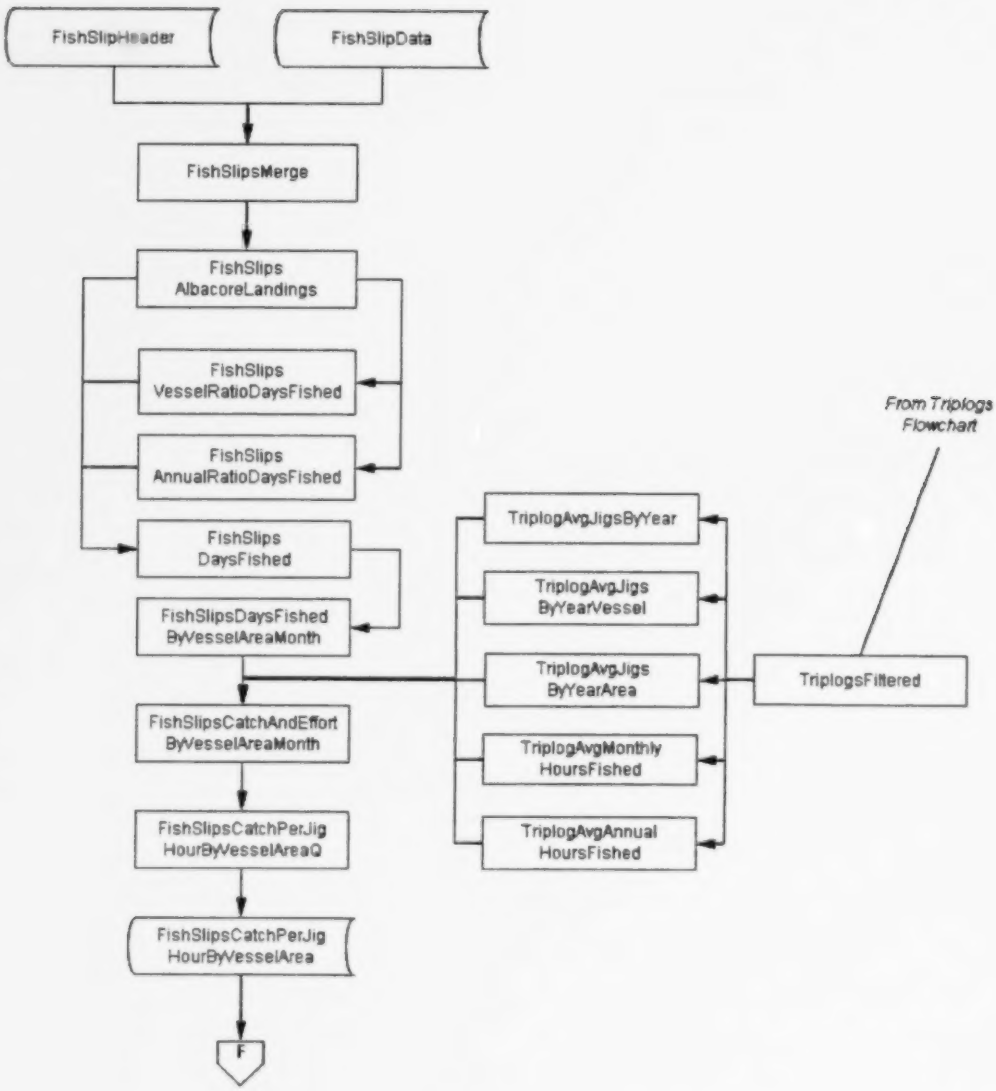


Figure 10b. Saleslips analytical flow model: database objects.

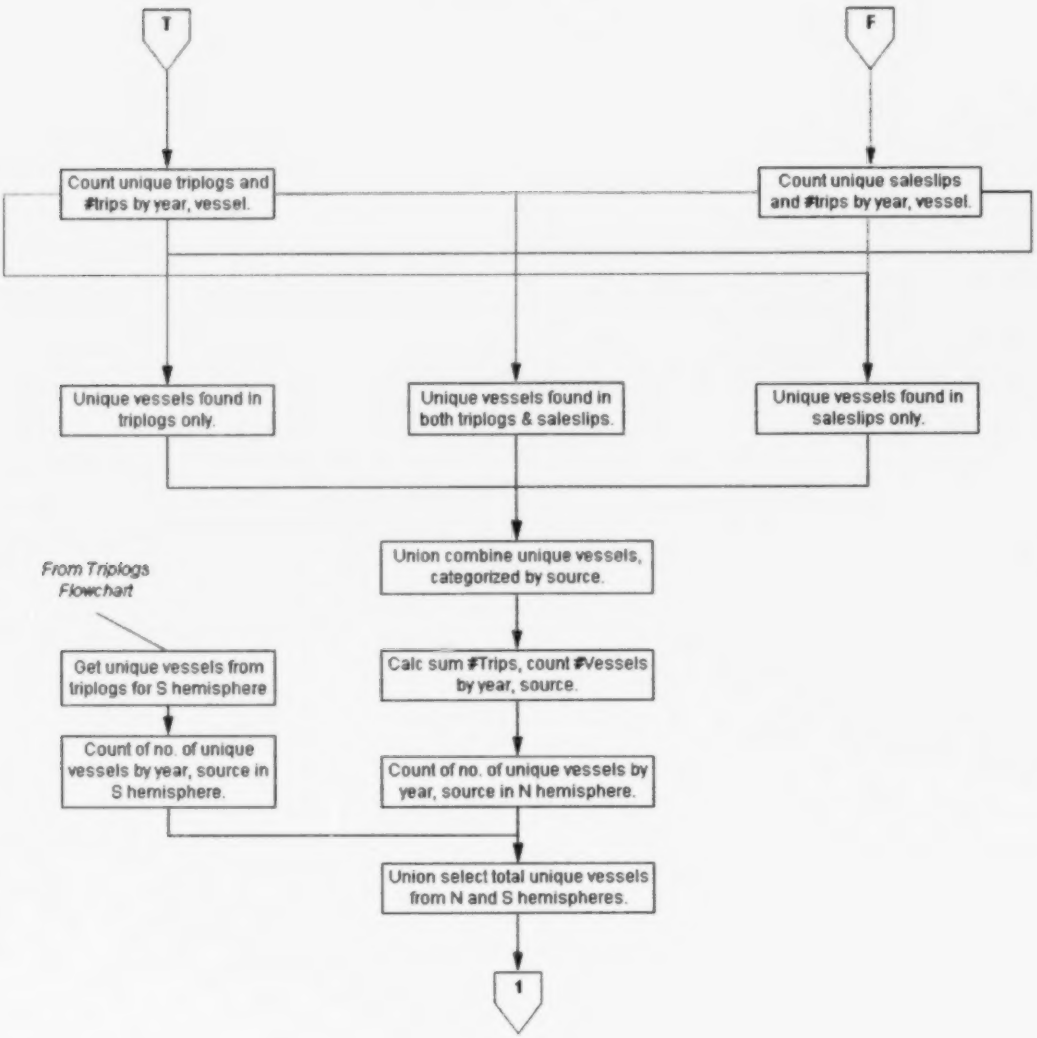

T
F
Count unique triplogs and #trips by year, vessel.
Count unique saleslips and #trips by year, vessel.
Unique vessels found in triplogs only.
Unique vessels found in both triplogs & saleslips.
Unique vessels found in saleslips only.
Union combine unique vessels, categorized by source.
From Triplogs Flowchart
Get unique vessels from triplogs for S hemisphere
Calc sum #Trips, count #Vessels by year, source.
Count of no. of unique vessels by year, source in S hemisphere.
Count of no. of unique vessels by year, source in N hemisphere.
Union select total unique vessels from N and S hemispheres.
1

Figure 11a. Unique vessels analytical flow model: pseudo-code.

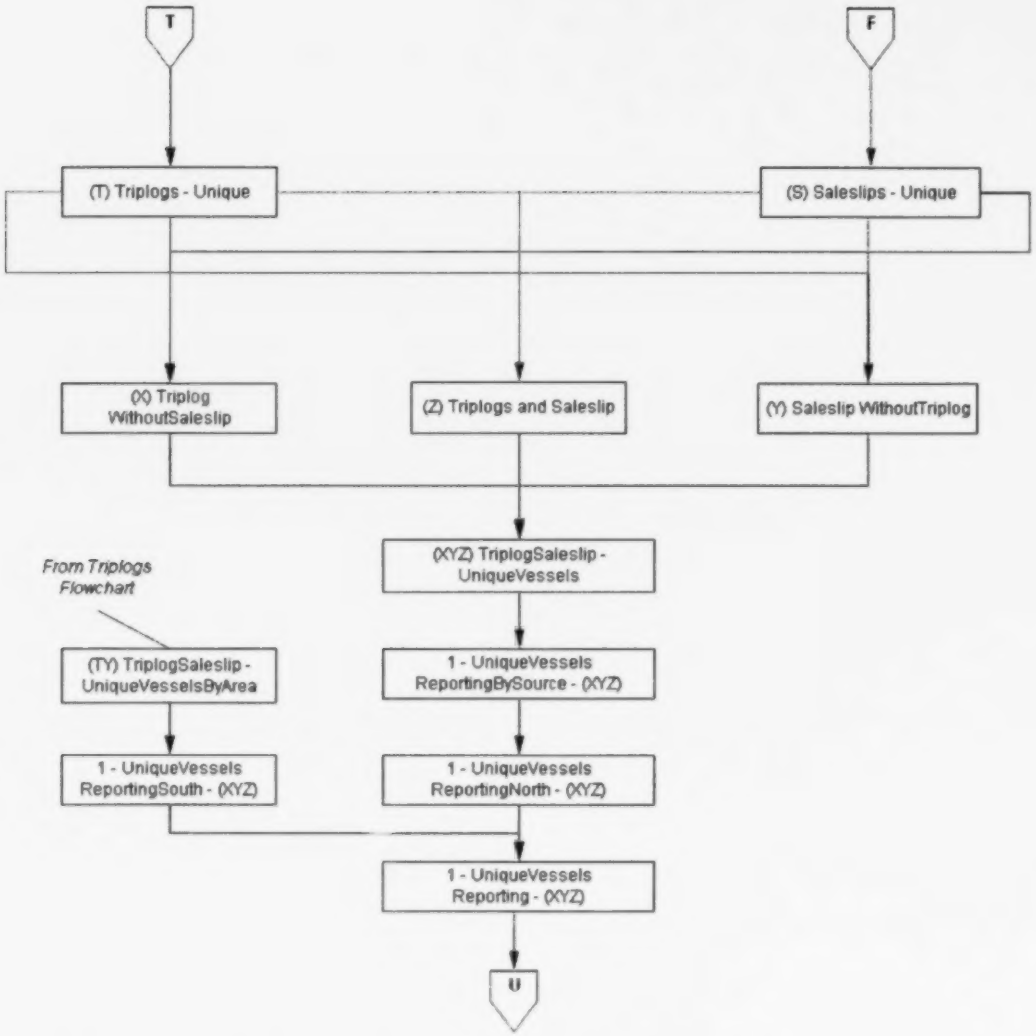


Figure 11b. Unique vessels analytical flow model: database objects.

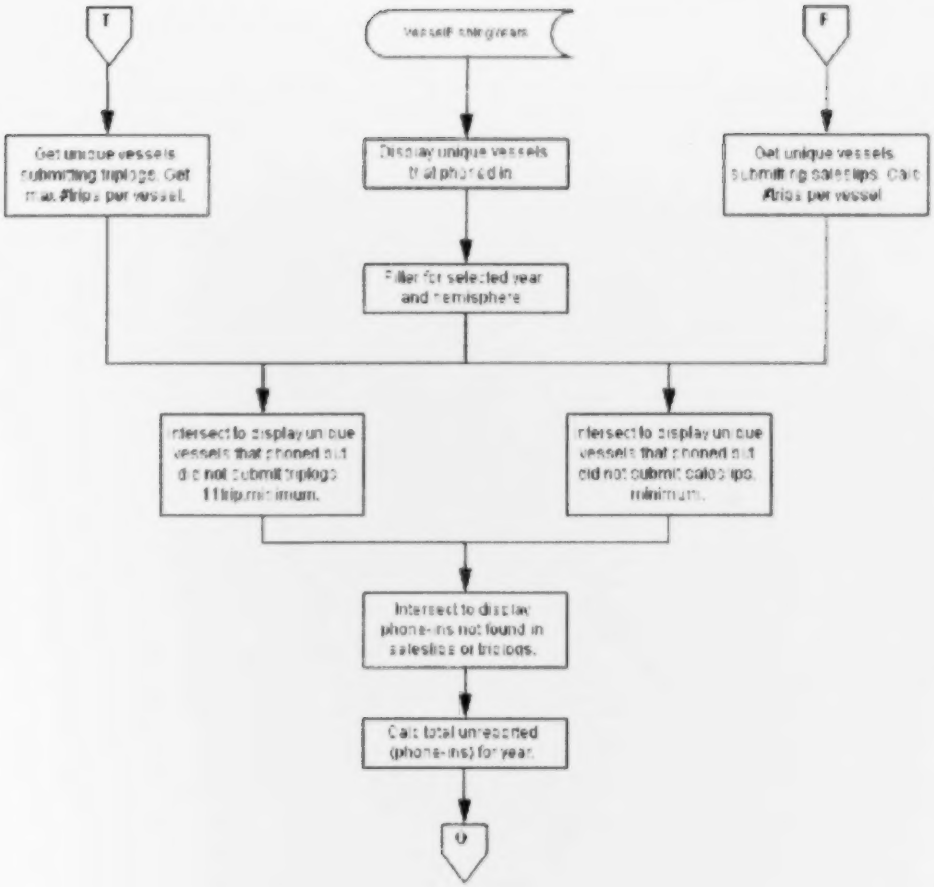

T
Vessel# entry/exam
F
Get unique vessels submitting triplogs. Get max #trips per vessel.
Display unique vessels that phoned in
Get unique vessels submitting salesslips. Calc #trips per vessel
Filter for selected year and hemisphere
Intersect to display unique vessels that phoned in & did not submit triplogs ≥1 trip minimum.
Intersect to display unique vessels that phoned in & did not submit salesslips ≥1 trip minimum.
Intersect to display phone-ins not found in salesslips or triplogs.
Calc total unreported (phone-ins) for year.
O

Figure 12a. Hail data analytical flow model: pseudo-code.

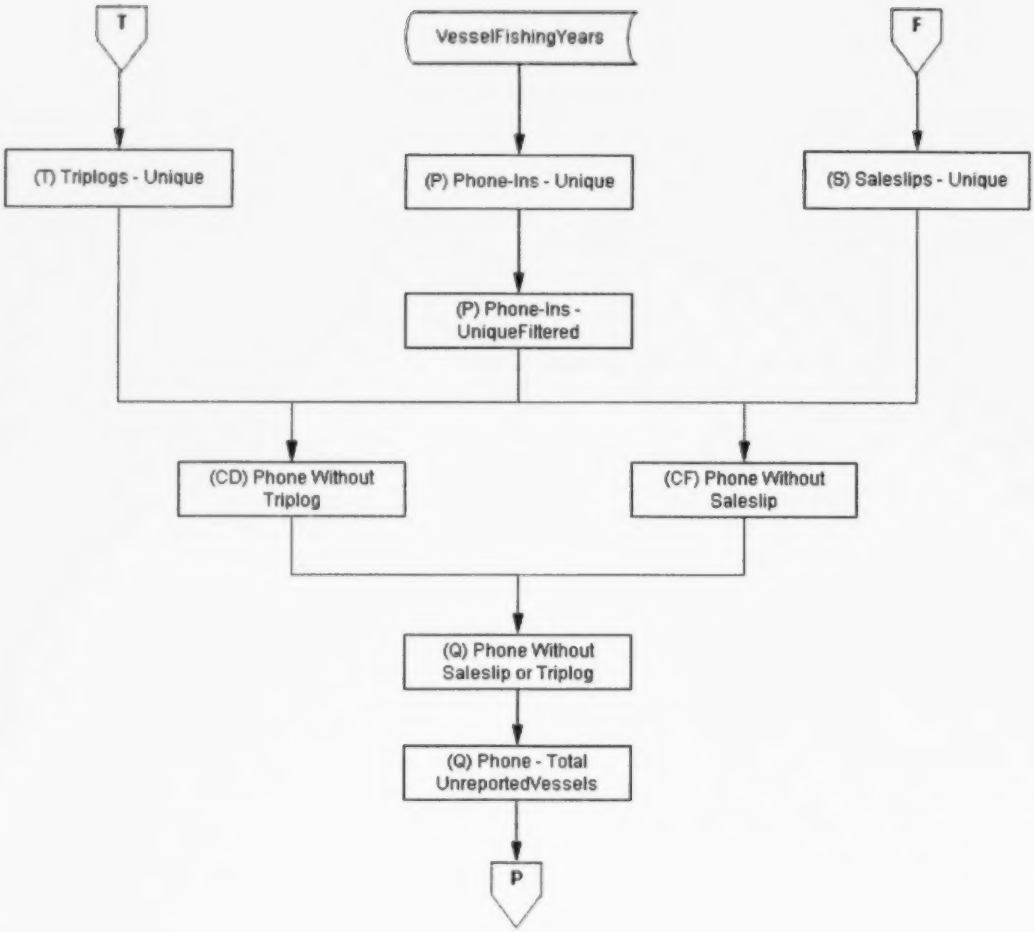


Figure 12b. Hail data analytical flow model: database objects.

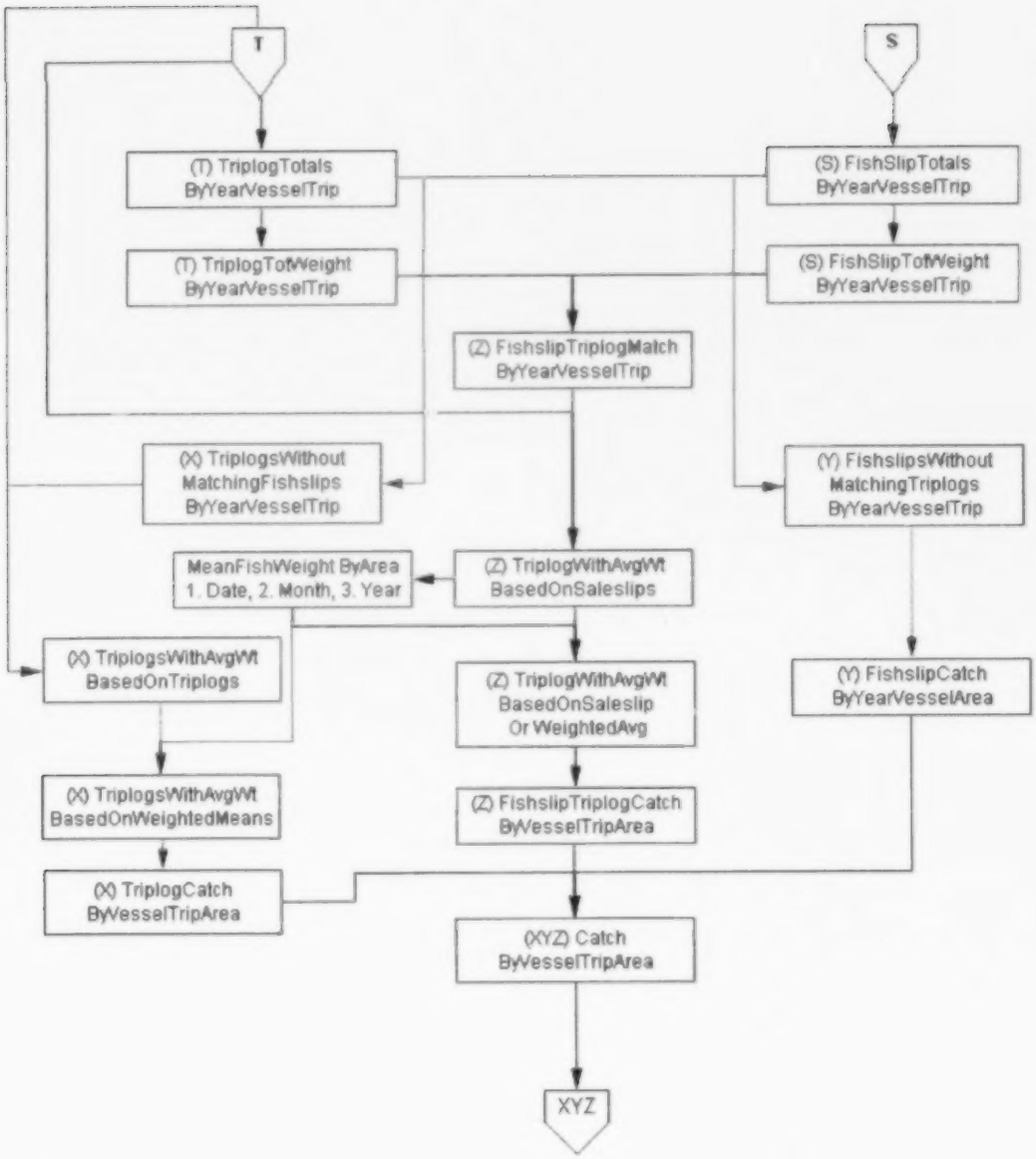


Figure 13a. Catch and effort analytical flow model (saleslips-based approach): pseudo-code.

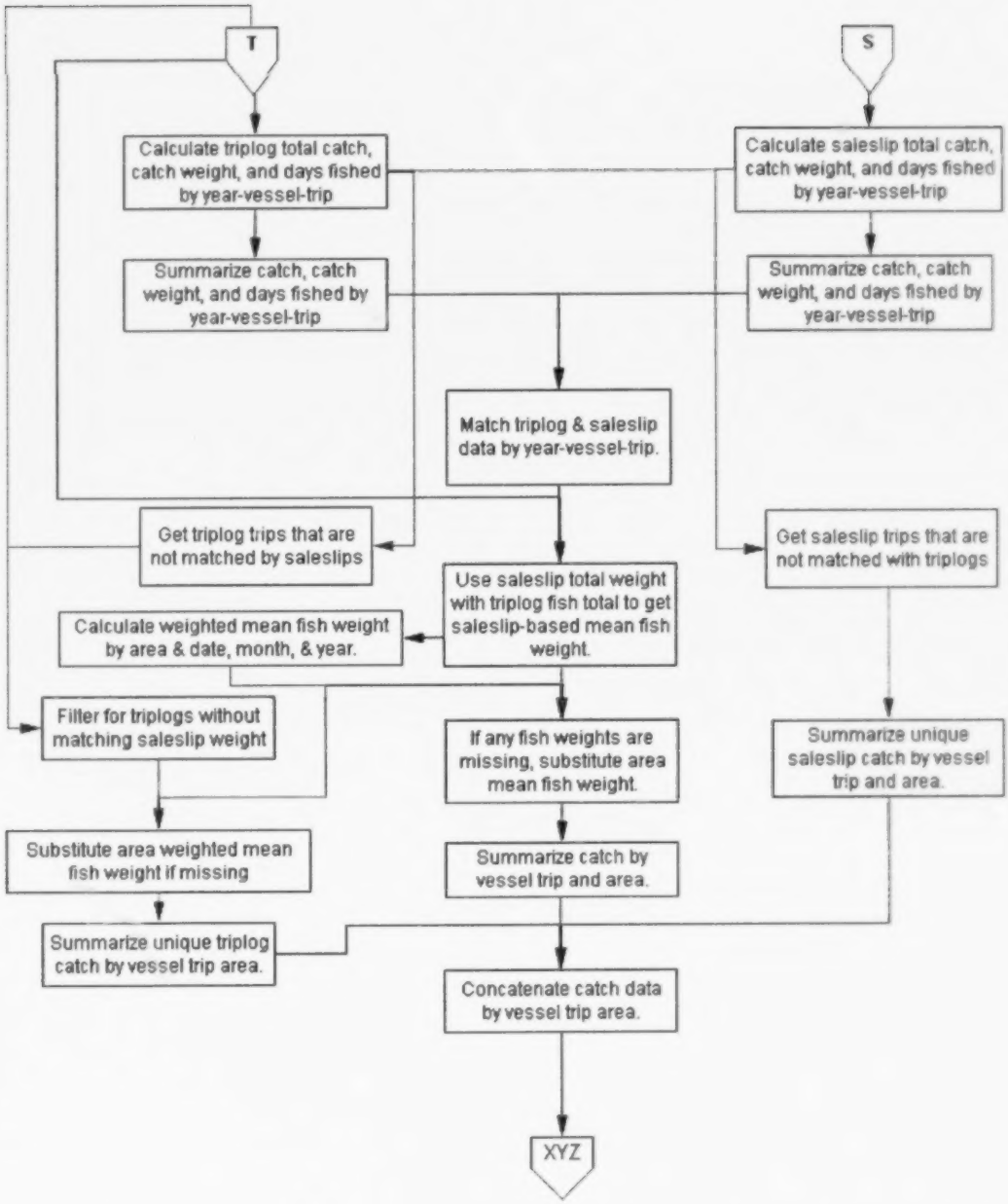

T
S
Calculate triplog total catch, catch weight, and days fished by year-vessel-trip
Calculate saleslip total catch, catch weight, and days fished by year-vessel-trip
Summarize catch, catch weight, and days fished by year-vessel-trip
Summarize catch, catch weight, and days fished by year-vessel-trip
Match triplog & saleslip data by year-vessel-trip.
Get triplog trips that are not matched by saleslips
Get saleslip trips that are not matched with triplogs
Use saleslip total weight with triplog fish total to get saleslip-based mean fish weight.
Calculate weighted mean fish weight by area & date, month, & year.
Filter for triplogs without matching saleslip weight
If any fish weights are missing, substitute area mean fish weight.
Summarize unique saleslip catch by vessel trip and area.
Substitute area weighted mean fish weight if missing
Summarize catch by vessel trip and area.
Summarize unique triplog catch by vessel trip area.
Concatenate catch data by vessel trip area.
XYZ

Figure 13b. Catch and effort analytical flow model (saleslips-based approach): database objects.

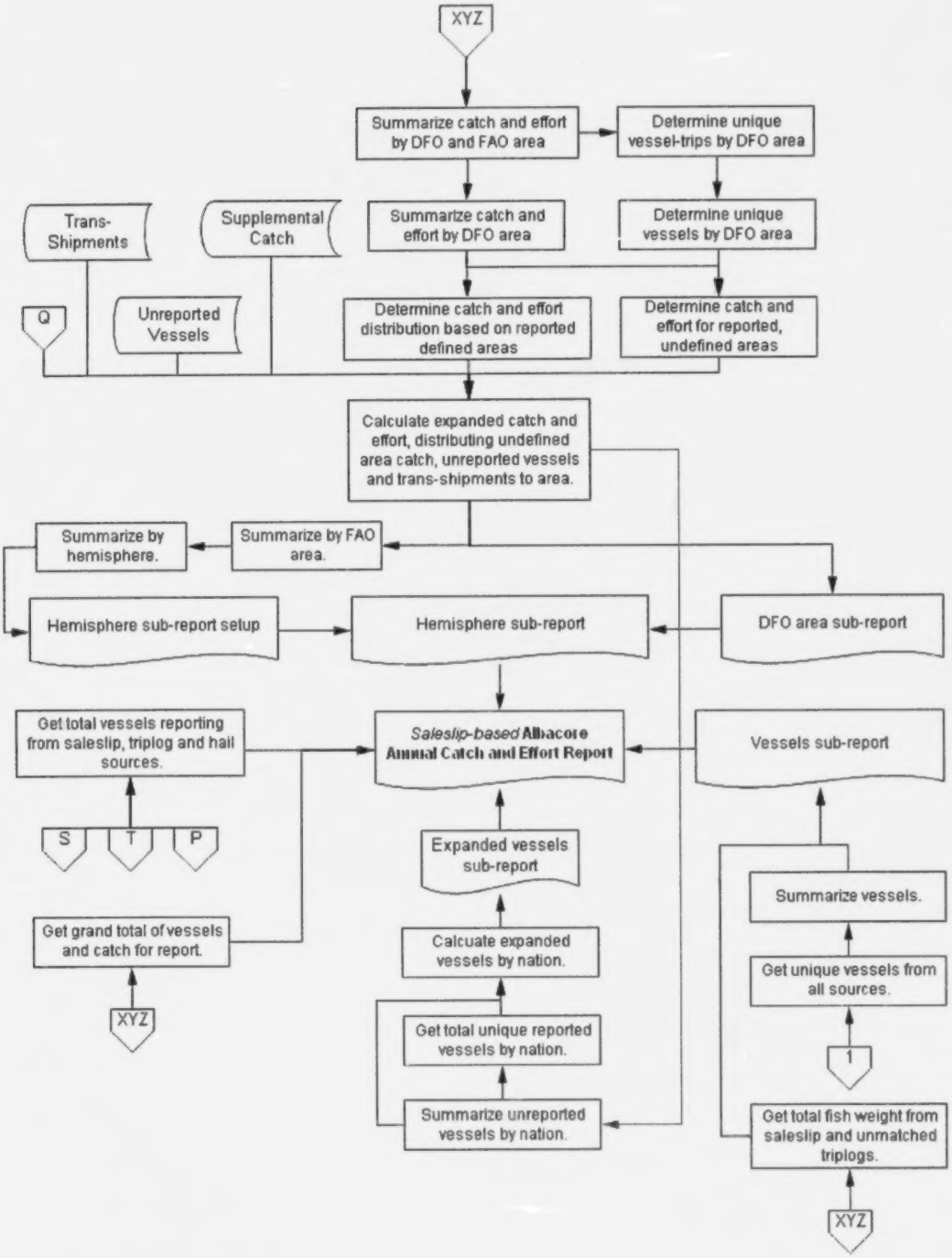

XYZ
Summarize catch and effort by DFO and FAO area
Determine unique vessel-trips by DFO area
Trans-Shipments
Supplemental Catch
Summarize catch and effort by DFO area
Determine unique vessels by DFO area
Q
Unreported Vessels
Determine catch and effort distribution based on reported defined areas
Determine catch and effort for reported, undefined areas
Calculate expanded catch and effort, distributing undefined area catch, unreported vessels and trans-shipments to area.
Summarize by hemisphere.
Summarize by FAO area.
Hemisphere sub-report setup
Hemisphere sub-report
DFO area sub-report
Get total vessels reporting from saleslip, triplog and hail sources.
Saleslip-based Albacore Annual Catch and Effort Report
Vessels sub-report
S
T
P
Expanded vessels sub-report
Summarize vessels.
Get grand total of vessels and catch for report.
Calcuate expanded vessels by nation.
Get unique vessels from all sources.
XYZ
Get total unique reported vessels by nation.
1
Summarize unreported vessels by nation.
Get total fish weight from saleslip and unmatched triplogs.
XYZ

Figure 13a (cont'd.). Catch and effort analytical flow model (saleslips-based approach): pseudo-code.

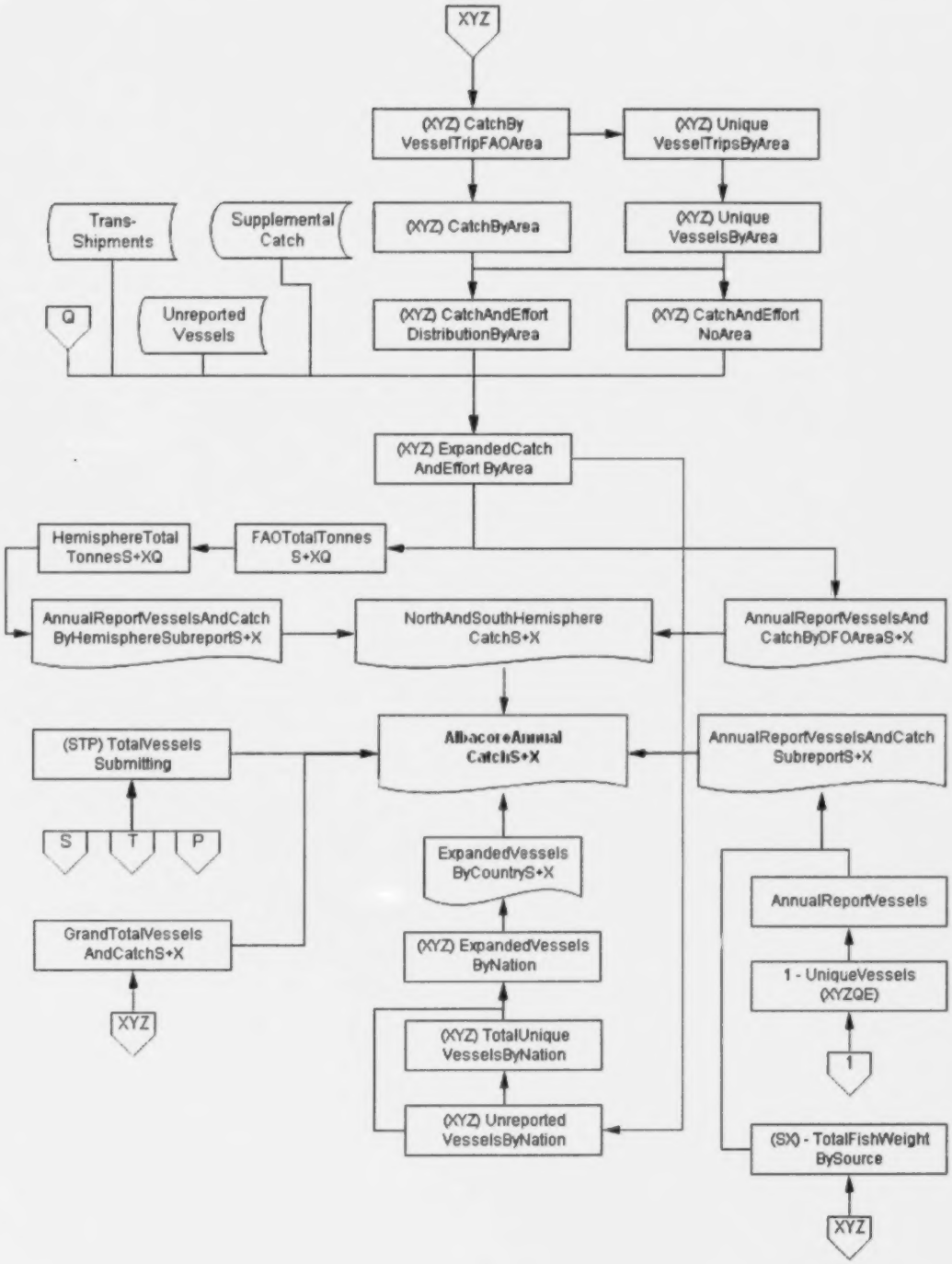


Figure 13b (cont'd.). Catch and effort analytical flow model (saleslips-based approach): database objects.

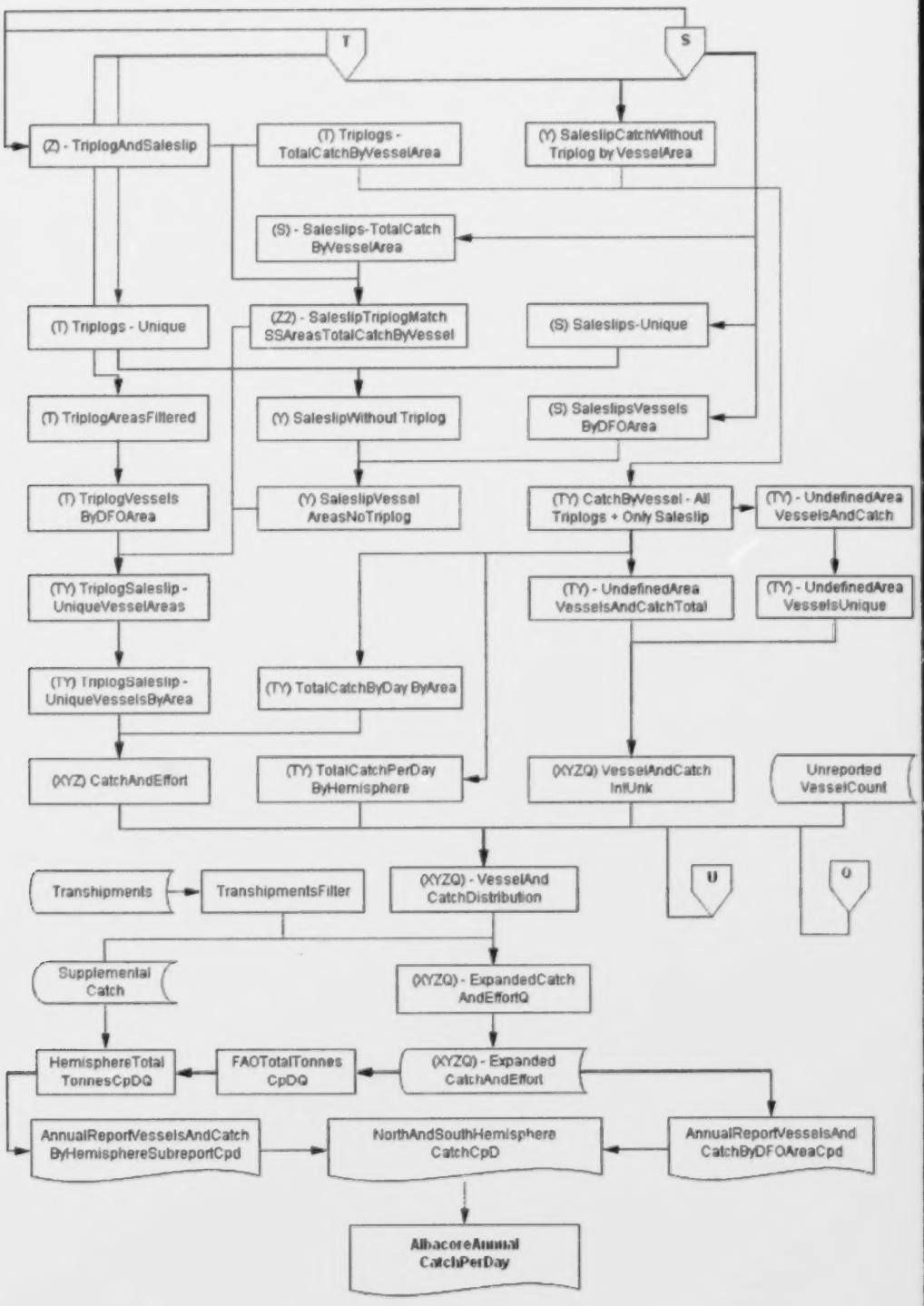


Figure 14a. Catch and effort analytical flow model (triplog-based approach): pseudo-code.

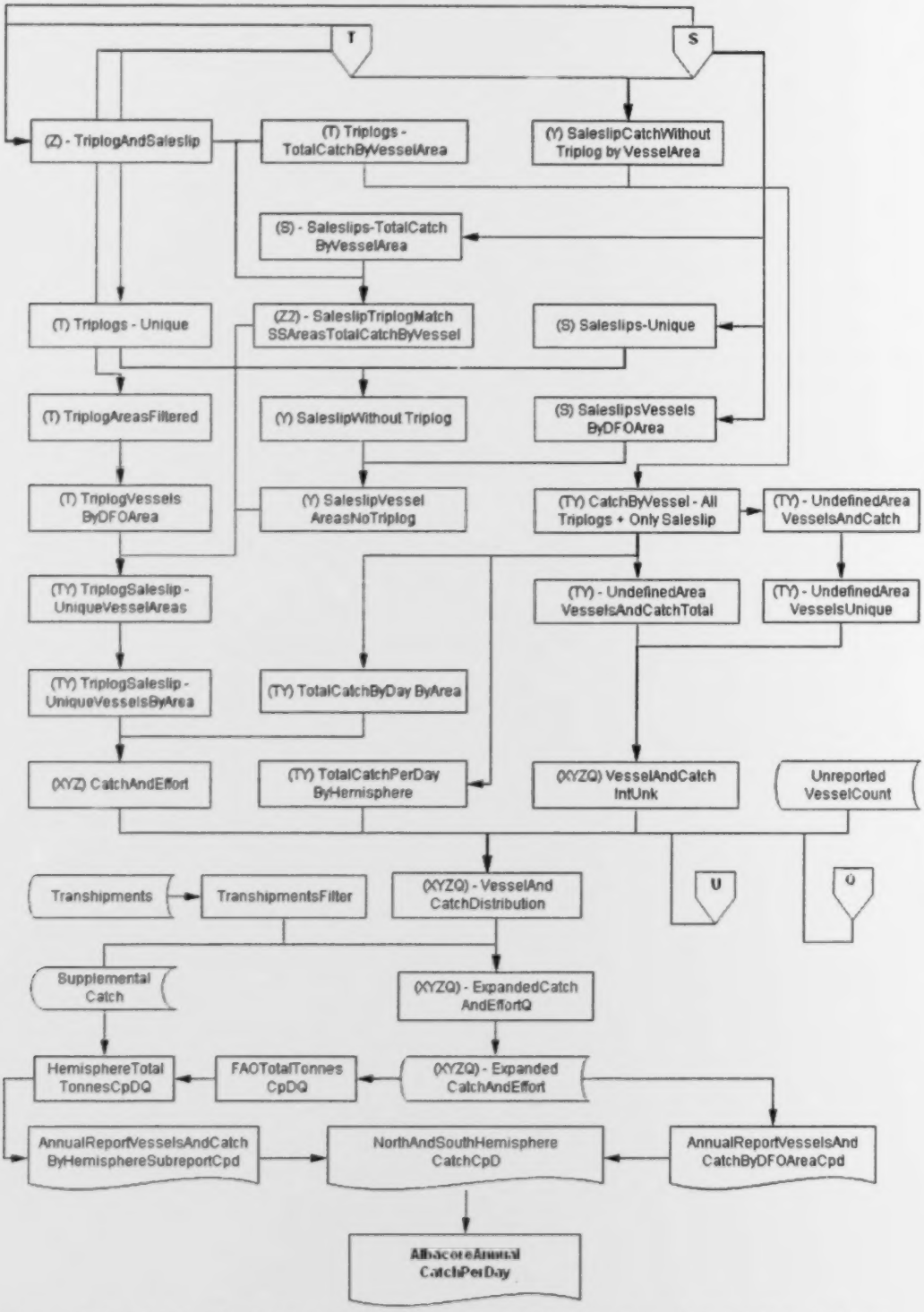


Figure 14b. Catch and effort analytical flow model (triplog-based approach): database objects.

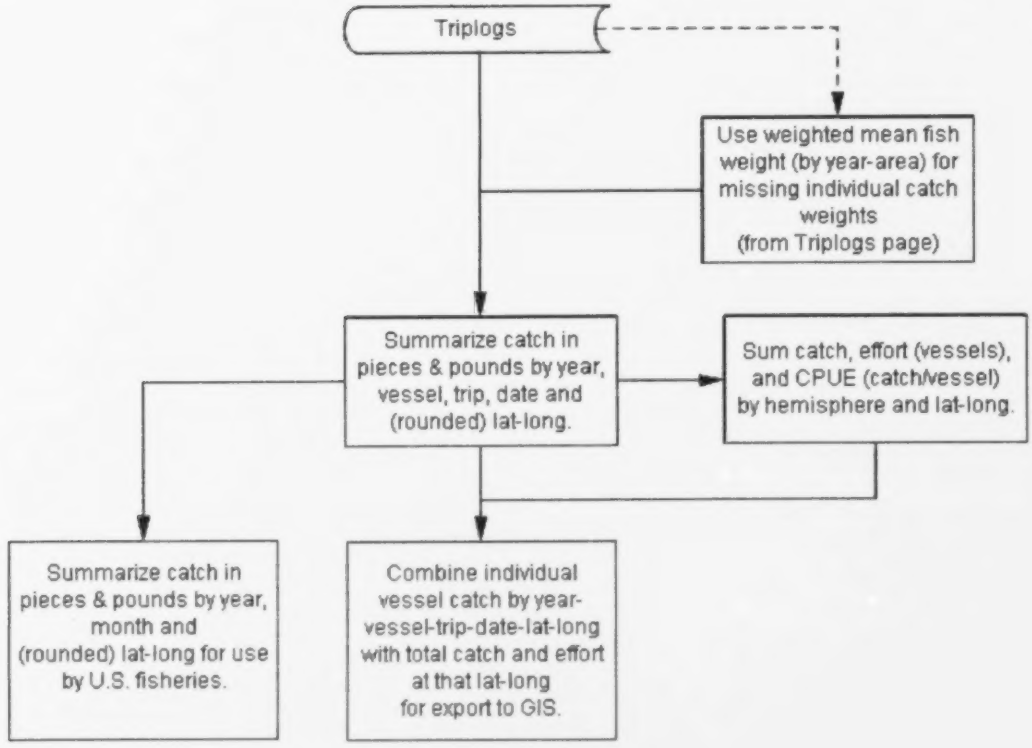

Triplogs
Use weighted mean fish weight (by year-area) for missing individual catch weights (from Triplogs page)
Summarize catch in pieces & pounds by year, vessel, trip, date and (rounded) lat-long.
Sum catch, effort (vessels), and CPUE (catch/vessel) by hemisphere and lat-long.
Summarize catch in pieces & pounds by year, month and (rounded) lat-long for use by U.S. fisheries.
Combine individual vessel catch by year-vessel-trip-date-lat-long with total catch and effort at that lat-long for export to GIS.

Figure 15a. Analytical flow model for catch, effort, and CPUE by year-vessel-trip-date at latitude and longitude coordinates, for export to GIS: pseudo-code.

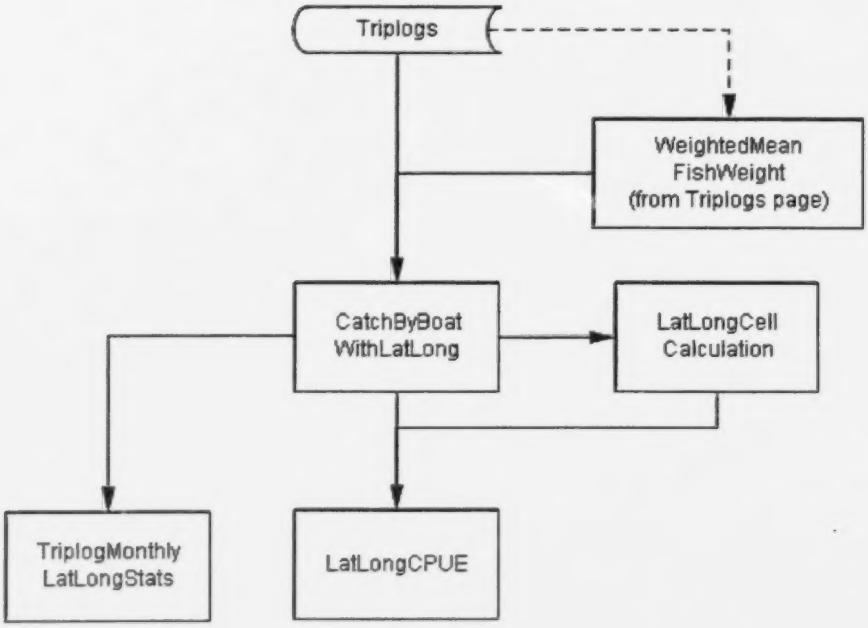


Figure 15b. Analytical flow model for catch, effort, and CPUE by year-vessel-trip-date at latitude and longitude coordinates, for export to GIS: database objects.

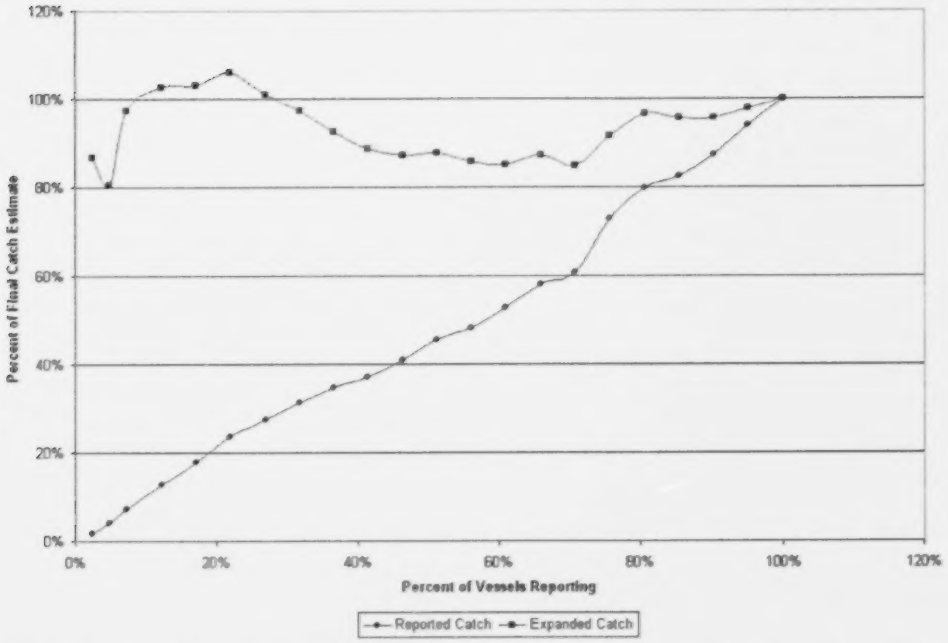


Figure 16. Reported and expanded albacore catch as a function of percent of vessels reporting (2005 simulation). Expanded catch estimates begin to stabilize and approach the final reported catch estimate after approximately 30-40% of the vessels have reported.

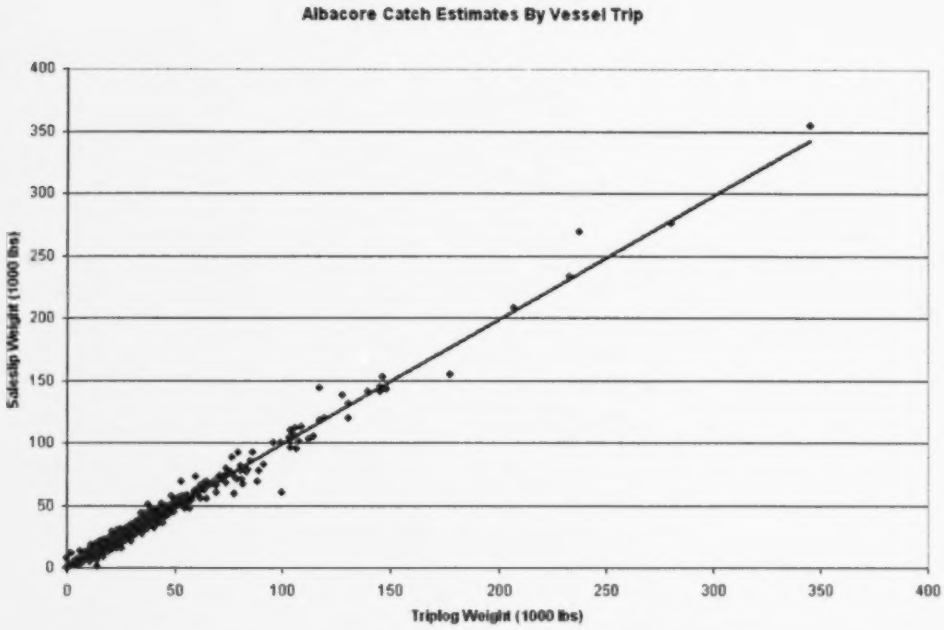


Figure 17. Saleslip trip catch weight as a function of triplog trip catch weight, 1995-2005. ($r^2 = 0.987$, b = 0.991, Prob(b=1) = 0.326, N = 2730)

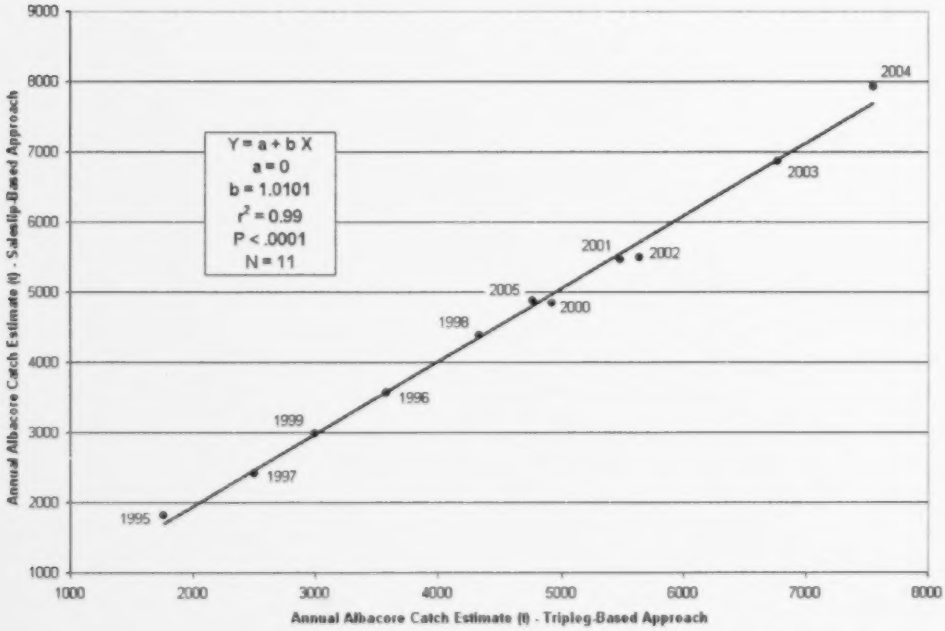


Figure 18. Comparison of post-season catch estimates based on triplog-based approach ($T+Y$) and saleslip-based approach ($S+X$).

9. TABLES

Table 1. Total reported catch, supplemental catch, and percent supplemental of total catch from the Albacore Tuna Relational Database, 1995-2005 (see Appendix 1 for historical catch, 1939-1994).

Year	Total Catch (lbs)	Supplemental Catch (lbs)	Percent Supplemental
1995	2,690,294	19,618	0.73%
1996	4,093,977	295,465	7.22%
1997	3,418,374	49,186	1.44%
1998	7,818,823	139,073	1.78%
1999	5,703,129	171,059	3.00%
2000	8,691,469	169,019	1.94%
2001	11,322,378	153,267	1.35%
2002	10,019,259	1,037,463	10.35%
2003	14,772,224	N/A	N/A
2004	15,804,135	N/A	N/A
2005	10,560,676	N/A	N/A

Table 2. DFO Albacore Tuna Fishing Areas and associated FAO areas.

Area	Area Name	FAO	FAO Area	Nation
BC	British Columbia	67	Northeast Pacific	CANADA
WA	Washington	67	Northeast Pacific	USA
OR	Oregon	67	Northeast Pacific	USA
CA-N	California	67	Northeast Pacific	USA
CA-S	California	77	Eastern Central Pacific	USA
US	United States	67	Northeast Pacific	USA
MX	Mexico	77	Eastern Central Pacific	OFFSHORE
InConv	InConvention	UNK	Unknown	OFFSHORE
OutConv	OutConvention	UNK	Unknown	OFFSHORE
NWP-IC	NW Pacific - InConv	61	Northwest Pacific	OFFSHORE
NEP-IC	NE Pacific - InConv	67	Northeast Pacific	OFFSHORE
NEP-OC	NE Pacific - OutConv	67	Northeast Pacific	OFFSHORE
WCP-IC	WC Pacific - InConv	71	West Central Pacific	OFFSHORE
ECP-IC	EC Pacific - InConv	77	Eastern Central Pacific	OFFSHORE
ECP-OC	EC Pacific - OutConv	77	Eastern Central Pacific	OFFSHORE
SWP-OC	SW Pacific – OutConv	81	Southwest Pacific	OFFSHORE
SWP-IC	SW Pacific - InConv	81	Southwest Pacific	OFFSHORE
SEP-IC	SE Pacific - InConv	87	Southeast Pacific	OFFSHORE
INT	International	UNK	Unknown	UNKNOWN
UNK	Unknown	UNK	Unknown	UNKNOWN

Table 3. Annual record of unique vessels fishing and percent of vessels submitting triplogs in Canadian albacore tuna fishing fleet. Unique Vessels Fishing represents the number of unique vessels active in the fishery based on triplog data, saleslip data, or other data sources. Percent Triplog Submission represents percent of vessels submitting triplogs as a function of total unique vessels fishing.

Year	Vessels Submitting Triplogs	Vessels Submitting Saleslips	Other Vessels	Unique Vessels Fishing	% Triplog Submission
1990	15	73		76	20%
1991	9	42		45	20%
1992	18	118		120	15%
1993	13	90		90	14%
1994	11	84	1	98	13%
1995	51	177	94	285	18%
1996	72	146	134	295	24%
1997	60	124	56	200	30%
1998	110	167	32	217	51%
1999	170	188	18	238	71%
2000	166	184	40	243	68%
2001	200	201	11	248	81%
2002	170	100	22	232	73%
2003	185	162	1	193	96%
2004	202	196	7	221	91%
2005	198	174	3	212	93%

Table 4. Example catch and effort summary report (T+Y method).

Fisheries and Oceans / Pêches et Océans — Canada

1998 Albacore Tuna Catch Summary Report

[Preliminary]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	110	110	4,984,365	2,261
Saleslips	167	75	2,733,747	1,240
Hails	118	19		
Estimated		13		
		217	7,718,112	3,501

	Unique Vessels	Expanded Vessels
CAN	93	124
USA	90	120

A

D E F G H I J K L M

North Pacific Vessels & Catch

B

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	4	64	180,030	0.6	6.0	11,914	15.23	2,741.4	0.47	0.27	5	81	223,070	101		
61			64	180,030		6	11,914						81	223,070	101	0	**181**
67	BC	93	1,035	565,818	13.9	97.3	37,446	10.60	532.8	10.98	6.35	124	1,316	701,090	316		
	WA	60	613	676,872	8.9	57.6	44,795	9.72	1,076.5	7.08	4.10	80	779	838,894	380		
	OR	72	1,843	2,389,625	10.7	173.3	158,145	24.37	1,263.7	8.50	4.92	96	2,343	2,960,922	1,343		
	CA-N	2	11	14,011	0.3	1.0	927	5.24	1,241.3	0.24	0.14	3	14	17,361	8		
	US	3	26	114,460	0.4	2.4	7,575	8.18	4,330.3	0.35	0.20	4	33	141,824	64		
	NEP-IC	21	209	861,358	3.1	19.7	57,004	9.49	4,011.1	2.48	1.43	28	266	1,067,286	484		
	NEP-OC	32	809	2,063,899	4.8	76.0	136,588	24.06	2,487.0	3.78	2.19	43	1,028	2,557,323	1,160		
67			4,545	6,686,043		427	442,481						5,779	8,284,501	3,758	63	**3,821**
77	CA-S	4	52	17,962	0.8	4.9	1,189	12.38	336.6	0.47	0.27	5	66	22,256	10		
	ECP-IC	8	93	209,296	1.2	8.7	13,851	11.04	2,198.9	0.94	0.55	11	118	259,333	118		
	ECP-OC	6	32	30,279	0.9	3.0	2,004	5.08	922.1	0.71	0.41	8	41	37,518	17		
77			177	257,537		17	17,044						225	319,107	145	102	**247**
Subtotal			4,786	7,123,610		450	471,439						6,085	8,826,679	4,004	165	**4,169**

South Pacific Vessels & Catch

C

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	SWP-IC	1	37	123,063	0.0	0.0	0	37.00	3,326.0	0.00	2.00	3	111	369,189	167		
81			37	123,063		0	0						111	369,189	167	0	**167**
Subtotal			37	123,063		0	0						111	369,189	167	0	**167**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	161	4,823	7,246,673	24	450	471,439	185	5,273	7,718,112	41,720	29	1,464	217	9,195,868	4,171	165	**4,336**

N

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Since Triplog catch is used instead of saleslip catch when both exist for a given vessel and fishing area, Triplog vessels may include vessels from other sources. However, Saleslip vessels represent vessels that only submitted saleslips and Phone-Ins represent vessels that only phoned in. Total unique saleslip vessels (75) is partitioned into defined area vessels (52) and undefined area vessels (23).

3 Triplog catch is based on no. fish x daily mean weight, or (if absent) weighted annual area mean weight. Triplog and Saleslip weights include Albacore only.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Note that some vessels may fish in more than one area. Days=Days Fished. Saleslip vessels & catch from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch tonnes (63) and Trans-shipment tonnage (102), which were not recorded in either saleslips or triplog catch data.

Table 5. Example catch and effort summary report (*S+X* method).

Fisheries and Oceans / Pêches et Océans — Canada

1998 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

A

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	110	110	5,085,076	2,307
Saleslips	167	75	2,733,747	1,240
Hails	118	19		
Estimated		13		
		217	**7,818,823**	**3,547**

	Unique Vessels	Expanded Vessels
CAN	93	124
USA	90	120

D E F G H I J K L M

North Pacific Vessels & Catch

B

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	4	64	169,682	0.6	6.0	11,073	15.23	2,581.6	0.47	0.27	5	81	210,067	95		
61			64	169,682		6	11,073						81	210,067	95	0	**95**
67	BC	93	1,035	556,165	13.9	97.3	36,294	10.60	523.2	10.98	6.35	124	1,316	688,533	312		
	WA	60	613	866,521	8.9	57.6	43,495	9.72	1,059.1	7.08	4.10	80	779	825,154	374		
	OR	72	1,843	2,373,115	10.7	173.3	154,863	24.37	1,253.9	8.50	4.92	96	2,343	2,937,921	1,333		
	CA-N	2	11	16,715	0.3	1.0	1,091	5.24	1,479.6	0.24	0.14	3	14	20,693	9		
	US	3	26	114,460	0.4	2.4	7,469	8.18	4,326.6	0.35	0.20	4	33	141,702	64		
	NEP-IC	21	209	982,219	3.1	19.7	64,097	9.49	4,570.0	2.48	1.43	26	266	1,215,989	552		
	NEP-OC	32	809	2,090,670	4.8	76.0	136,431	24.06	2,517.1	3.76	2.19	43	1,028	2,588,253	1,174		
67			4,545	6,799,865		427	443,740						5,779	8,418,244	3,816	63	**3,882**
77	CA-S	4	52	16,194	0.6	4.9	1,057	12.38	303.2	0.47	0.27	5	66	20,048	9		
	ECP-IC	8	93	209,773	1.2	8.7	13,689	11.04	2,202.0	0.94	0.55	11	118	259,699	118		
	ECP-OC	6	32	26,807	0.9	3.0	1,880	5.08	876.6	0.71	0.41	8	41	35,663	16		
77			177	254,774		17	16,626						225	315,410	143	102	**245**
Subtotal			4,786	7,224,321		450	471,439						6,085	8,943,721	4,057	165	**4,222**

South Pacific Vessels & Catch

C

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	1	37	123,063	0.0	0.0	0	37.00	3,326.0	0.00	2.00	3	111	369,189	167		
81			37	123,063		0	0						111	369,189	167	0	**167**
Subtotal			37	123,063		0	0						111	369,189	167	0	**167**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	161	4,823	7,347,384	24	450	471,439	185	5,273	7,818,823	42,264	29	1,483	217	9,312,910	4,224	165	**4,389**

N

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).
2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (75) is partitioned into defined area vessels (52) and undefined area vessels (23).
3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.
4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.
5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.
6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.
7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.
8 OTHER includes Supplemental catch tonnes (63) and Trans-shipment tonnage (102), which were not recorded in either saleslips or triplog catch data.

2006 CANADIAN PACIFIC ALB

Vessel Name: _____ FIN

Sales Slip #_____ Gear Type_____

Total # of Fish Offloaded: _____ Offload Date: _____ Total

Date (mm/dd)	Total Hours Fished	Position Latitude/Longitude		# of Jigs Used	T
			N		
			S		
			E		
			W		
			N		
			S		
			E		
			W		
			N		
			S		
			E		
			W		
			N		
			S		
			E		
			W		
			N		
			S		
			E		
			W		
			N		
			S		
			E		
			W		

SPECIES CODE	ALB - Albacore Tuna	YT
	BIG - Bigeye Tuna	

TRIP COMMENTS:

Prepared by Canadian Highly Migratory Species Foundation - March 2006

Table 6. Logbook data form used on albacore tuna fishery vessels, 2006.

BACORE TUNA LOG BOOK

SUBMISSION DEADLINE: OCT 31, 2006

Captain's Name: _____ Hull #: _____

Offloading Port: _____ Buyer: _____

Weight Offloaded: _____ Day's Fished: _____ Page ____ of ____ for this trip

Water Temp (F)	Species	# of Fish	Ave. Wt. Per Fish	Remarks (Weather, Fleet Size, etc.)
	ALB			
	ALB			
	ALB			
	ALB			
	ALB			
	ALB			
	ALB			

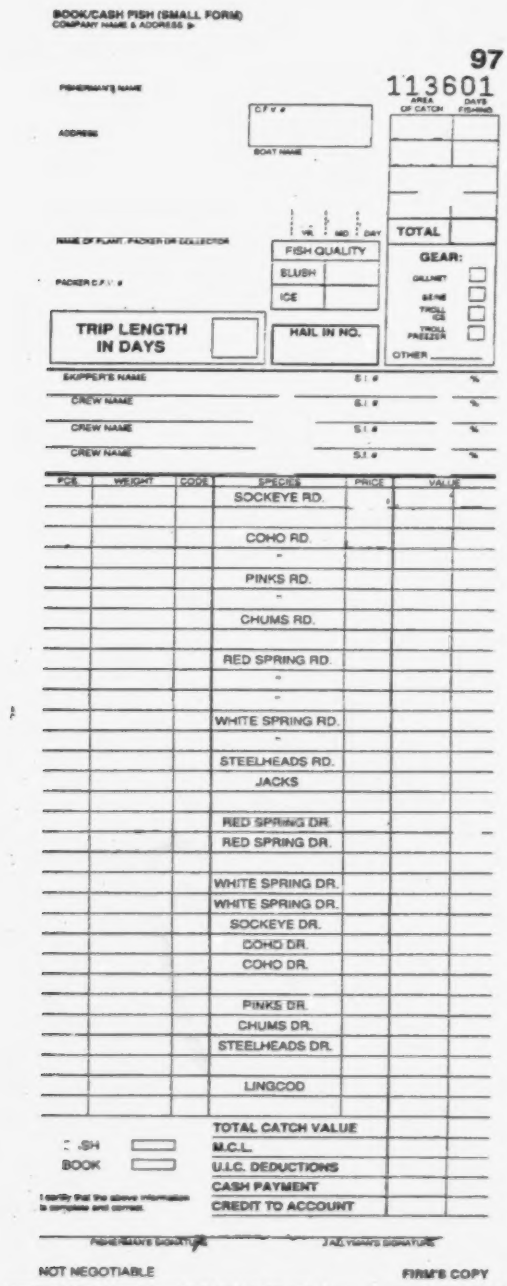
L - Yellowtail Rockfish YFN - Yellowfin Tuna SKJ - Skipjack Tuna

MHI - Mahi Mahi SWD - Swordfish WAH - Wahoo

White Copy: Remove and Mail to Howard Skill

Yellow Copy: Retain for Fisher Records

Table 7. Saleslip data form used in the albacore tuna fishery.



BOOK/CASH FISH (SMALL FORM)
COMPANY NAME & ADDRESS ▶

97
113601
AREA OF CATCH | DAYS FISHING

FISHERMAN'S NAME
ADDRESS
C.F.V. #
BOAT NAME
TOTAL
NAME OF PLANT, PACKER OR COLLECTOR
YR. MO. DAY
FISH QUALITY
SLUSH
ICE
GEAR:
GILLNET
SEINE
TROLL ICE
TROLL FREEZER
OTHER
PACKER C.F.V. #
TRIP LENGTH IN DAYS
HAIL IN NO.
SKIPPER'S NAME S.I. # %
CREW NAME S.I. # %
CREW NAME S.I. # %
CREW NAME S.I. # %

PCS.	WEIGHT	CODE	SPECIES	PRICE	VALUE
			SOCKEYE RD.		
			COHO RD.		
			"		
			PINKS RD.		
			"		
			CHUMS RD.		
			RED SPRING RD.		
			"		
			"		
			WHITE SPRING RD.		
			"		
			STEELHEADS RD.		
			JACKS		
			RED SPRING DR.		
			RED SPRING DR.		
			WHITE SPRING DR.		
			WHITE SPRING DR.		
			SOCKEYE DR.		
			COHO DR.		
			COHO DR.		
			PINKS DR.		
			CHUMS DR.		
			STEELHEADS DR.		
			LINGCOD		
			TOTAL CATCH VALUE		
			M.C.L.		
			U.I.C. DEDUCTIONS		
			CASH PAYMENT		
			CREDIT TO ACCOUNT		

CASH
BOOK

I certify that the above information is complete and correct.

FISHERMAN'S SIGNATURE
PACKER'S SIGNATURE

NOT NEGOTIABLE
FIRM'S COPY

Table 8. Example catch and effort summary report for the month of July (*T+Y* method).

Fisheries and Oceans / Pêches et Océans — Canada

Jul 2005 Albacore Tuna Catch Summary Report [Preliminary]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	120	120	2,316,153	1,051
Saleslips	53	2	48,117	22
Hails	207	85		
Estimated		0		
		207	**2,364,270**	**1,072**

	Unique Vessels	Expanded Vessels
CAN	21	36
USA	117	199

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
67	BC	21	38	20,182	0.0	0.0	0	1.81	531.1	14.63	0.00	36	64	34,243	16		
	WA	106	508	373,955	0.0	0.0	0	4.79	736.1	73.85	0.00	180	862	634,497	288		
	OR	114	1,438	1,968,314	0.0	0.0	0	12.62	1,368.5	79.43	0.00	193	2,440	3,339,681	1,515		
	CA-N	1	1	405	0.0	0.0	0	1.00	405.0	0.70	0.00	2	2	687	0		
	NEP-OC	1	1	1,414	0.0	0.0	0	1.00	1,414.0	0.70	0.00	2	2	2,399	1		
67			1,986	2,364,270		0	0					3,370	4,011,507	1,820		0	**1,820**
Subtotal			1,986	2,364,270		0	0					3,370	4,011,507	1,820		0	**1,820**

South Pacific Vessels & Catch

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	122	1,986	2,364,270		0	0	122	1,986	2,364,270	19,379	16	1,190	207	4,011,507	1,820	0	**1,820**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Since Triplog catch is used instead of saleslip catch when both exist for a given vessel and fishing area, Triplog vessels may include vessels from other sources. However, Saleslip vessels represent vessels that only submitted saleslips and Phone-Ins represent vessels that only phoned in. Total unique saleslip vessels (2) is partitioned into defined area vessels (2) and undefined area vessels (0).

3 Triplog catch is based on no. fish x daily mean weight, or (if absent) weighted annual area mean weight. Triplog and Saleslip weights include Albacore only.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Note that some vessels may fish in more than one area. Days=Days Fished. Saleslip vessels & catch from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch tonnes (0) and Trans-shipment tonnage (0), which were not recorded in either saleslips or triplog catch data.

Table 9. Correlation and regression analysis of saleslip landings as a function of triplog landings, by year, vessel, and trip.

Year	N	r^2	b	Prob b=0	Prob b=1
1995	37	0.95	1.110	0.0001	0.0086
1996	89	0.95	0.970	0.0001	0.1928
1997	44	0.97	0.854	0.0001	0.0001
1998	155	0.99	1.007	0.0001	0.1874
1999	216	0.99	0.953	0.0001	0.0001
2000	317	0.99	0.944	0.0001	0.0001
2001	357	0.99	0.982	0.0001	0.0001
2002	115	0.99	0.991	0.0001	0.0342
2003	425	0.99	0.982	0.0001	0.0019
2004	590	0.99	0.996	0.0001	0.4135
2005	385	0.99	1.064	0.0001	0.0001

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10. APPENDICES

Appendix 1. Historical Canadian albacore tuna jig-troll catch (tonnes), 1939-1994.[1]

Year	Catch (t)	Year	Catch (t)
1939	129	1967	161
1940	2	1968	1,028
1941	35	1969	1,365
1942	-	1970	390
1943	13	1971	1,746
1944	210	1972	3,921
1945	648	1973	1,400
1946	196	1974	1,331
1947	36	1975	111
1948	984	1976	278
1949	1,012	1977	53
1950	961	1978	23
1951	86	1979	521
1952	71	1980	212
1953	5	1981	200
1954	-	1982	104
1955	-	1983	225
1956	17	1984	50
1957	8	1985	56
1958	74	1986	30
1959	212	1987	104
1960	5	1988	155
1961	4	1989	140
1962	1	1990	302
1963	5	1991	139
1964	3	1992	363
1965	15	1993	494
1966	44	1994	1,998

[1] 1939-1946 Anon. (1917-1950); 1947-1969, 1977-1990 Ware and Yamanaka (1991); 1970-1976, 1991-1994 Stocker (2005).

Appendix 2. Canadian albacore tuna jig-troll catch estimates from the Albacore Tuna Relational Database, 1995-2005.

Appendix 2.1. Canadian albacore tuna jig-troll catch (tonnes), 1995.

Fisheries and Oceans / Pêches et Océans — Canada

1995 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	Reported Catch[3] (t)
Triplogs	51	51	958,044	435
Saleslips	177	142	1,732,250	786
Hails	176	81		
Estimated		13		
		287	2,690,294	1,220

	Unique Vessels	Expanded Vessels
CAN	175	284
USA	9	15

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
67	BC	175	3,504	2,179,264	18.0	350.4	180,923	19.97	612.3	73.45	11.00	277	5,541	3,392,869	1,539		
	WA	9	119	60,760	0.9	11.9	5,044	13.19	502.7	3.78	0.57	14	188	94,596	43		
	OR	2	2	982	0.2	0.2	82	1.00	483.4	0.84	0.13	3	3	1,529	1		
	NEP-IC	2	11	32,480	0.2	1.1	2,697	5.49	2,907.1	0.84	0.13	3	17	50,568	23		
	NEP-OC	6	114	210,580	0.6	11.4	17,482	18.95	1,818.7	2.52	0.38	10	180	327,850	149		
67			3,750	2,484,066		375	206,228						5,930	3,867,411	1,754	9	1,763
Subtotal			3,750	2,484,066		375	206,228						5,930	3,867,411	1,754	9	1,763

South Pacific Vessels & Catch

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	175	3,750	2,484,066	18	375	206,228	193	4,125	2,690,294	13,939	21	652	287	3,867,411	1,754	9	1,763

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).
2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (142) is partitioned into defined area vessels (124) and undefined area vessels (18).
3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.
4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days= Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.
5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.
6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.
7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.
8 OTHER includes Supplemental catch + lost logbook tonnage estimates (9) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.2. Canadian albacore tuna jig-troll catch (tonnes), 1996.

Fisheries and Oceans / Pêches et Océans — Canada

1996 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	72	72	2,382,910	1,081
Saleslips	146	89	1,711,067	776
Hails	255	121		
Estimated		13		
		295	**4,093,977**	**1,857**

	Unique Vessels	Expanded Vessels
CAN	90	177
USA	83	163

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	2	21	10,936	0.3	2.5	1,058	10.28	511.0	1.50	0.16	4	41	20,708	9		
61			21	10,936		2	1,058						41	20,708	9	0	**9**
67	BC	90	1,455	625,585	12.8	171.2	60,520	15.83	421.8	67.64	7.02	177	2,808	1,184,570	537		
	WA	34	105	96,754	4.8	12.4	9,360	3.02	904.2	25.55	2.65	67	203	183,207	83		
	OR	80	1,924	1,533,019	11.3	226.3	148,305	23.54	782.1	60.12	6.24	158	3,712	2,902,831	1,317		
	CA-N	5	8	4,631	0.7	0.9	448	1.57	568.1	3.76	0.39	10	15	8,770	4		
	US	4	125	53,868	0.6	14.7	5,211	30.59	422.9	3.01	0.31	8	241	102,001	46		
	NEP-IC	13	214	907,398	1.8	25.2	87,777	16.11	4,160.5	9.77	1.01	26	413	1,716,081	779		
	NEP-OC	18	258	364,389	2.6	30.4	35,251	14.03	1,385.9	13.53	1.40	35	498	689,985	313		
67			4,089	3,585,584		481	346,872						7,890	6,789,446	3,080	134	**3,214**
77	CA-S	1	23	6,985	0.1	2.7	676	22.51	298.0	0.75	0.08	2	44	13,226	6		
	ECP-IC	3	35	24,836	0.4	4.1	2,403	11.42	696.3	2.25	0.23	6	68	47,027	21		
	ECP-OC	6	56	49,456	0.9	6.6	4,784	9.14	866.6	4.51	0.47	12	108	93,647	42		
77			114	81,276		13	7,863						220	153,900	70	23	**93**
Subtotal			4,224	3,677,797		497	355,793						8,151	6,964,054	3,159	157	**3,316**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	1	56	60,387	0.0	0.0	0	56.00	1,078.3	0.00	2.00	3	168	181,161	82		
81			56	60,387		0	0						168	181,161	82	0	**82**
Subtotal			56	60,387		0	0						168	181,161	82	0	**82**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	141	4,280	3,738,184	20	497	355,793	161	4,777	4,093,977	25,428	30	857	295	7,145,215	3,241	157	**3,398**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip.
Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in.
Total unique saleslip vessels (89) is partitioned into defined area vessels (69) and undefined area vessels (20).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel.
Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost logbook tonnage estimates (134) and Trans-shipment tonnage (23) not recorded in either saleslips or triplog catch data.

Appendix 2.3. Canadian albacore tuna jig-troll catch (tonnes), 1997.

Fisheries and Oceans / Pêches et Océans — Canada

1997 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	60	60	2,123,862	963
Saleslips	124	84	1,294,512	587
Hails	130	43		
Estimated		13		
		200	**3,418,374**	**1,551**

	Unique Vessels	Expanded Vessels
CAN	67	119
USA	59	104

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	7	59	149,338	2.2	13.5	31,178	7.91	2,489.2	2.09	0.70	12	95	235,462	107		
61			59	149,338		14	31,178						95	235,462	107	0	**107**
67	BC	67	631	217,014	20.7	144.5	45,306	8.84	338.5	20.01	6.70	114	1,011	342,196	155		
	WA	44	520	380,136	13.6	119.2	79,362	11.10	718.9	13.14	4.40	75	834	599,413	272		
	OR	35	608	467,329	10.8	139.4	97,565	16.32	755.6	10.45	3.50	60	975	736,900	334		
	CA-N	2	7	2,043	0.6	1.6	426	3.29	286.9	0.60	0.20	3	11	3,221	1		
	US	2	33	3,498	0.6	7.6	730	15.49	104.2	0.60	0.20	3	53	5,516	3		
	NEP-IC	20	496	1,164,474	6.2	113.7	243,109	23.29	2,308.8	5.97	2.00	34	795	1,836,185	833		
	NEP-OC	17	138	159,338	5.3	31.6	33,265	7.62	1,135.5	5.08	1.70	29	221	251,251	114		
67			2,433	2,393,833		558	499,764						3,901	3,774,881	1,712	22	**1,734**
77	CA-S	4	63	22,114	1.2	14.4	4,617	14.79	345.2	1.19	0.40	7	101	34,870	16		
	ECP-IC	8	79	95,626	2.5	18.1	19,964	9.27	1,190.4	2.39	0.80	14	127	150,787	68		
	ECP-OC	7	63	76,245	2.2	14.4	15,918	8.45	1,190.2	2.09	0.70	12	101	120,227	55		
77			205	193,986		47	40,499						329	305,883	139	188	**327**
Subtotal			2,697	2,737,157		618	571,440						4,324	4,316,047	1,958	210	**2,168**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	1	57	109,777	0.0	0.0	0	57.00	1,925.9	0.00	2.00	3	171	329,331	149		
81			57	109,777		0	0						171	329,331	149	0	**149**
Subtotal			57	109,777		0	0						171	329,331	149	0	**149**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	110	2,754	2,846,934	34	618	571,440	144	3,372	3,418,374	23,739	23	1,014	200	4,845,378	2,107	210	**2,317**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (84) is partitioned into defined area vessels (50) and undefined area vessels (34).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost logbook tonnage estimates (22) and Trans-shipment tonnage (188) not recorded in either saleslips or triplog catch data.

Appendix 2.4. Canadian albacore tuna jig-troll catch (tonnes), 1998.

Fisheries and Oceans / Pêches et Océans — Canada

1998 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	110	110	5,085,076	2,307
Saleslips	167	75	2,733,747	1,240
Hails	118	19		
Estimated		13		
		217	**7,818,823**	**3,547**

	Unique Vessels	Expanded Vessels
CAN	92	119
USA	91	118

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	4	64	169,682	0.6	5.6	10,638	15.23	2,591.5	0.41	0.27	5	80	207,259	94		
61			64	169,682		6	10,638						80	207,259	94	0	**94**
67	BC	92	1,020	539,958	13.1	89.0	33,826	10.56	517.1	9.45	6.25	121	1,275	859,055	299		
	WA	60	613	666,521	8.5	53.4	41,785	9.72	1,063.2	6.16	4.07	79	768	814,123	369		
	OR	72	1,843	2,373,115	10.2	160.7	148,773	24.37	1,258.7	7.39	4.89	95	2,303	2,898,642	1,315		
	CA-N	2	11	16,715	0.3	1.0	1,048	5.24	1,485.3	0.21	0.14	3	14	20,416	9		
	US	5	71	148,503	0.7	6.2	9,310	13.47	2,051.4	0.51	0.34	7	88	181,369	82		
	NEP-IC	21	209	982,219	3.0	18.3	61,576	9.49	4,587.5	2.16	1.43	28	262	1,199,732	544		
	NEP-OC	32	809	2,090,670	4.5	70.5	131,066	24.06	2,526.7	3.29	2.17	42	1,011	2,553,849	1,158		
67			4,575	6,817,311		399	427,383						5,718	8,327,006	3,777	63	**3,840**
77	CA-S	4	52	16,194	0.6	4.5	1,015	12.38	304.4	0.41	0.27	5	65	19,780	9		
	ECP-IC	8	93	209,773	1.1	8.1	13,151	11.04	2,210.5	0.82	0.54	11	116	256,227	116		
	ECP-OC	6	32	28,807	0.9	2.8	1,806	5.06	879.9	0.62	0.41	8	40	35,187	16		
77			177	254,774		15	15,972						221	311,193	141	102	**243**
Subtotal			4,816	7,241,767		420	453,993						6,018	8,845,458	4,012	165	**4,177**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	1	37	123,063	0.0	0.0	0	37.00	3,326.0	0.00	2.00	3	111	369,189	167		
81			37	123,063		0	0						111	369,189	167	0	**167**
Subtotal			37	123,063		0	0						111	369,189	167	0	**167**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	162	4,853	7,364,830	23	420	453,993	185	5,273	7,818,823	42,264	29	1,483	217	9,214,647	4,180	165	**4,345**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).
2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip.
Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in.
Total unique saleslip vessels (75) is partitioned into defined area vessels (52) and undefined area vessels (23).
3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.
4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished.
Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.
5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.
6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.
7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel.
Expanded Catch = Expanded Days x Catch per Day.
8 OTHER includes Supplemental catch + lost logbook tonnage estimates (63) and Trans-shipment tonnage (102) not recorded in either saleslips or triplog catch data.

Appendix 2.5. Canadian albacore tuna jig-troll catch (tonnes), 1999.

Fisheries and Oceans / Pêches et Océans — Canada

1999 Albacore Tuna Catch Summary Report

[Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	170	170	4,722,815	2,142
Saleslips	188	50	980,314	445
Hails	161	9		
Estimated		9		
		238	5,703,129	2,587

	Unique Vessels	Expanded Vessels
CAN	162	173
USA	176	188

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	5	85	96,846	0.0	0.0	0	17.00	1,139.4	0.21	0.16	5	91	103,922	47		
61			85	96,846		0	0						91	103,922	47	0	**47**
67	BC	162	1,574	900,084	0.0	0.0	0	9.72	571.8	6.66	5.18	174	1,689	965,843	438		
	WA	164	1,812	1,804,915	0.0	0.0	0	11.05	885.6	6.74	5.24	176	1,945	1,722,169	781		
	OR	107	1,796	1,547,806	0.0	0.0	0	16.78	861.9	4.40	3.42	115	1,927	1,660,887	753		
	CA-N	17	77	53,190	0.0	0.0	0	4.50	695.3	0.70	0.54	18	82	57,076	26		
	NEP-IC	13	80	79,005	0.0	0.0	0	6.15	987.6	0.53	0.42	14	86	84,777	38		
	NEP-OC	29	514	483,715	0.0	0.0	0	17.72	941.1	1.19	0.93	31	552	519,055	235		
67			5,853	4,868,714		0	0						6,280	5,009,807	2,272	78	**2,350**
77	CA-S	18	337	377,291	0.0	0.0	0	18.72	1,119.6	0.74	0.58	19	362	404,856	184		
	ECP-IC	7	140	135,046	0.0	0.0	0	20.00	964.5	0.29	0.22	8	150	144,913	66		
	ECP-OC	10	80	89,202	0.0	0.0	0	8.00	1,115.0	0.41	0.32	11	86	95,719	43		
77			557	601,540		0	0						598	645,488	293	44	**337**
Subtotal		6,495	5,367,100			0	0						6,969	5,759,217	2,612	122	**2,734**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	3	118	336,029	0.0	0.0	0	39.40	2,842.8	0.00	2.00	5	197	560,048	254		
81			118	336,029		0	0						197	560,048	254	0	**254**
Subtotal			118	336,029		0	0						197	560,048	254	0	**254**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	220	6,613	5,703,129	0	0	0	220	6,613	5,703,129	25,923	30	862	238	6,319,265	2,866	122	**2,988**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (50) is partitioned into defined area vessels (50) and undefined area vessels (0).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost logbook tonnage estimates (78) and Trans-shipment tonnage (44) not recorded in either saleslips or triplog catch data.

Appendix 2.6. Canadian albacore tuna jig-troll catch (tonnes), 2000.

Fisheries and Oceans / Pêches et Océans — Canada

2000 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	166	166	7,361,023	3,339
Saleslips	184	37	1,330,446	603
Hails	205	38		
Estimated		2		
		243	8,691,469	3,942

	Unique Vessels	Expanded Vessels
CAN	131	155
USA	184	218

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	NWP-IC	10	280	380,030	0.0	1.0	1,109	27.96	1,356.6	1.67	0.00	12	333	452,134	205		
81			280	380,030		1	1,109						333	452,134	205	0	**205**
67	BC	131	999	788,453	0.6	3.4	2,301	7.61	788.9	24.52	0.00	156	1,189	938,048	425		
	WA	147	1,214	880,774	0.7	4.1	2,570	8.25	725.2	27.52	0.00	175	1,445	1,047,884	475		
	OR	161	4,325	5,078,586	0.8	14.7	14,820	26.82	1,173.7	30.14	0.00	192	5,148	6,042,155	2,741		
	CA-N	6	28	2,362	0.0	0.1	7	4.67	84.0	1.12	0.00	7	33	2,810	1		
	US	2	29	14,929	0.0	0.1	44	14.48	514.5	0.37	0.00	2	35	17,762	8		
	NEP-IC	8	178	493,979	0.0	0.6	1,442	22.24	2,771.2	1.50	0.00	10	212	587,703	267		
	NEP-OC	18	192	358,068	0.1	0.7	1,045	10.65	1,864.1	3.37	0.00	21	229	426,004	193		
67			6,965	7,617,150		24	22,229						8,291	9,062,366	4,111	77	**4,188**
77	CA-S	6	65	45,044	0.0	0.2	131	10.82	692.7	1.12	0.00	7	77	53,591	24		
	ECP-IC	7	53	210,572	0.0	0.2	614	7.57	3,964.9	1.31	0.00	8	63	250,525	114		
	ECP-OC	3	4	528	0.0	0.0	2	1.33	131.9	0.56	0.00	4	5	626	0		
77			122	256,145		0	747						145	304,743	138	0	**138**
Subtotal			7,367	8,253,325		25	24,085						8,769	9,819,243	4,454	77	**4,531**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	3	209	414,059	0.0	0.0	0	69.67	1,981.1	0.00	2.00	5	348	690,098	313		
81			209	414,059		0	0						348	690,098	313	0	**313**
Subtotal			209	414,059		0	0						348	690,098	313	0	**313**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED			Other	
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch				Vess.	Catch (lbs)	(t)	(t)	Total
Total	202	7,576	8,667,384	1	25	24,085	203	7,601	8,691,469	42,815	37	1,143	243	10,509,341	4,767	77	**4,844**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).
2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip.
Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in.
Total unique saleslip vessels (37) is partitioned into defined area vessels (36) and undefined area vessels (1).
3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.
4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished.
Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.
5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.
6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.
7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel.
Expanded Catch = Expanded Days x Catch per Day.
8 OTHER includes Supplemental catch + lost log-book tonnage estimates (77) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.7. Canadian albacore tuna jig-troll catch (tonnes), 2001.

Fisheries and Oceans / Pêches et Océans — Canada

2001 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	200	200	9,541,246	4,328
Saleslips	201	36	1,781,132	808
Hails	224	12		
Estimated		0		
		248	**11,322,378**	**5,136**

	Unique Vessels	Expanded Vessels
CAN	176	185
USA	207	217

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	7	169	698,083	0.0	0.0	0	24.14	4,130.7	0.36	0.00	7	178	733,579	333		
61			169	698,083		0	0						178	733,579	333	0	**333**
67	BC	176	1,669	1,459,549	0.0	0.0	0	9.48	874.3	8.95	0.00	185	1,754	1,533,763	696		
	WA	194	3,303	3,260,824	0.0	0.0	0	17.03	993.2	9.86	0.00	204	3,471	3,447,646	1,564		
	OR	169	3,616	4,196,626	0.0	0.0	0	21.40	1,161.1	8.59	0.00	178	3,800	4,412,118	2,001		
	CA-N	18	110	127,767	0.0	0.0	0	6.11	1,161.5	0.92	0.00	19	116	134,264	61		
	US	3	60	47,743	0.0	0.0	0	20.00	795.7	0.15	0.00	3	63	50,171	23		
	NEP-IC	7	96	428,133	0.0	0.0	0	13.72	4,458.3	0.36	0.00	7	101	449,902	204		
	NEP-OC	16	151	316,604	0.0	0.0	0	9.44	2,096.7	0.81	0.00	17	159	332,702	151		
67			9,006	9,859,248		0	0						9,464	10,360,566	4,700	70	**4,770**
77	CA-S	16	235	230,073	0.0	0.0	0	14.69	979.0	0.81	0.00	17	247	241,772	110		
	ECP-IC	5	99	66,948	0.0	0.0	0	19.80	676.2	0.25	0.00	5	104	70,352	32		
	ECP-OC	4	27	8,516	0.0	0.0	0	6.75	315.4	0.20	0.00	4	28	8,949	4		
77			361	305,538		0	0						379	321,074	146	0	**146**
Subtotal		9,536	10,862,869			0	0					10,021	11,415,218	5,178		70	**5,248**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	4	168	459,509	0.0	0.0	0	42.09	2,729.6	0.00	0.00	4	168	459,509	208		
81			168	459,509		0	0						168	459,509	208	0	**208**
Subtotal			168	459,509		0	0						168	459,509	208	0	**208**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED			Other	
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch				Vess.	Catch (lbs)	(t)	(t)	Total
Total	236	9,704	11,322,378	0	0	0	236	9,704	11,322,378	47,976	41	1,167	248	11,874,726	5,386	70	**5,456**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).
2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip.
Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in.
Total unique saleslip vessels (36) is partitioned into defined area vessels (36) and undefined area vessels (0).
3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.
4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished.
Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.
5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.
6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.
7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel.
Expanded Catch = Expanded Days x Catch per Day.
8 OTHER includes Supplemental catch + lost logbook tonnage estimates (70) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.8. Canadian albacore tuna jig-troll catch (tonnes), 2002.

Fisheries and Oceans / Pêches et Océans — Canada

2002 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	171	171	9,073,075	4,116
Saleslips	100	40	1,012,754	459
Hails	217	19		
Estimated		2		
		232	10,085,829	4,575

	Unique Vessels	Expanded Vessels
CAN	124	135
USA	200	218

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	6	97	307,196	0.0	0.0	0	16.17	3,167.0	0.54	0.00	7	106	334,858	152		
61			97	307,196		0	0						106	334,858	152	0	**152**
67	BC	124	629	770,301	0.0	0.0	0	5.07	1,224.6	11.17	0.00	135	686	839,664	381		
	WA	191	4,443	5,325,052	0.0	0.0	0	23.26	1,198.6	17.20	0.00	208	4,843	5,804,560	2,633		
	OR	133	1,979	2,745,451	0.0	0.0	0	14.88	1,387.3	11.98	0.00	145	2,157	2,992,672	1,357		
	CA-N	15	128	376,855	0.0	0.0	0	8.53	2,944.2	1.35	0.00	16	140	410,790	186		
	US	1	3	3,178	0.0	0.0	0	3.00	1,059.3	0.09	0.00	1	3	3,464	2		
	NEP-IC	3	19	14,925	0.0	0.0	0	6.33	785.5	0.27	0.00	3	21	16,269	7		
	NEP-OC	11	137	104,961	0.0	0.0	0	12.45	766.1	0.99	0.00	12	149	114,412	52		
67			7,338	9,340,723		0	0						7,998	10,181,831	4,616	471	**5,089**
77	CA-S	6	59	69,927	0.0	0.0	0	9.83	1,185.2	0.54	0.00	7	64	76,224	35		
	ECP-IC	4	113	202,447	0.0	0.0	0	28.25	1,791.8	0.36	0.00	4	123	220,877	100		
	ECP-OC	8	29	6,882	0.0	0.0	0	3.63	230.4	0.72	0.00	9	32	7,264	3		
77			201	279,056		0	0						219	304,184	138	0	**138**
Subtotal		7,636	9,926,975		0	0							8,323	10,820,873	4,908	471	**5,379**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	2	79	158,854	0.0	0.0	0	39.50	2,010.8	0.00	2.00	4	158	317,708	144		
81			79	158,854		0	0						158	317,708	144	0	**144**
Subtotal			79	158,854		0	0						158	317,708	144	0	**144**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	211	7,715	10,085,829	0	0	0	211	7,715	10,085,829	47,800	37	1,307	232	11,138,581	5,052	471	**5,523**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (40) is partitioned into defined area vessels (40) and undefined area vessels (0).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days= Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost logbook tonnage estimates (471) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.9. Canadian albacore tuna jig-troll catch (tonnes), 2003.

Fisheries and Oceans / Pêches et Océans — Canada

2003 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	185	185	14,678,566	6,658
Saleslips	162	7	380,443	173
Hails	173	1		
Estimated		0		
		193	**15,059,009**	**6,831**

	Unique Vessels	Expanded Vessels
CAN	119	125
USA	177	185

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	8	291	737,539	0.3	6.6	9,935	35.66	2,511.3	0.04	0.00	8	299	751,205	341		
61			291	737,539		7	9,935						299	751,205	341	0	**341**
67	BC	119	868	1,192,555	5.2	19.8	16,065	7.15	1,362.0	0.62	0.00	125	892	1,214,652	551		
	WA	172	2,718	4,390,846	7.5	62.1	59,148	15.49	1,600.7	0.90	0.00	180	2,794	4,472,206	2,029		
	OR	157	4,126	8,135,226	6.8	94.2	109,587	25.76	1,953.6	0.82	0.00	165	4,241	8,285,966	3,758		
	CA-N	7	51	137,488	0.3	1.2	1,852	7.14	2,671.2	0.04	0.00	7	52	140,036	64		
	NEP-IC	7	42	52,895	0.3	1.0	710	5.88	1,243.2	0.04	0.00	7	43	53,672	24		
	NEP-OC	6	24	6,226	0.3	0.5	84	3.92	257.0	0.03	0.00	6	25	6,341	3		
67			7,829	13,915,036		179	187,445						8,047	14,172,872	6,429	0	**6,429**
77	CA-S	2	23	7,069	0.1	0.5	95	11.27	304.5	0.01	0.00	2	24	7,200	3		
	ECP-IC	8	46	189,904	0.3	1.1	2,558	5.64	4,090.5	0.04	0.00	8	47	193,423	88		
	ECP-OC	4	11	232	0.2	0.3	3	2.70	20.9	0.02	0.00	4	11	237	0		
77			80	197,205		2	2,656						82	200,859	91	0	**91**
Subtotal			8,200	14,849,781		187	200,037						8,429	15,124,936	6,861	0	**6,861**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
71	WCP-IC	1	4	0	0.0	0.0	0	4.00	0.0	0.00	0.00	1	4	0	0		
71			4	0		0	0						4	0	0	0	**0**
Subtotal			4	0		0	0						4	0	0	0	**0**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	184	8,204	14,849,781	8	187	200,037	192	8,391	15,049,818	78,384	44	1,794	193	15,124,936	6,861	0	**6,861**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (7) is partitioned into defined area vessels (-1) and undefined area vessels (8).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost logbook tonnage estimates (0) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.10. Canadian albacore tuna jig-troll catch (tonnes), 2004.

Fisheries and Oceans / Pêches et Océans — Canada

2004 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	203	203	16,514,523	7,491
Saleslips	196	11	395,045	179
Hails	217	7		
Estimated		0		
		221	16,909,568	7,670

	Unique Vessels	Expanded Vessels
CAN	172	178
USA	202	208

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	3	60	94,172	0.0	0.0	0	20.00	1,569.5	0.10	0.00	3	62	97,253	44		
61			60	94,172		0	0						62	97,253	44	0	**44**
67	BC	172	2,058	2,826,734	0.0	0.0	0	11.97	1,373.5	5.63	0.00	178	2,125	2,919,197	1,324		
	WA	190	2,274	3,001,274	0.0	0.0	0	11.97	1,319.8	6.21	0.00	196	2,348	3,099,447	1,406		
	OR	184	5,003	10,475,088	0.0	0.0	0	27.19	2,093.8	6.02	0.00	190	5,167	10,817,731	4,907		
	CA-N	11	34	61,182	0.0	0.0	0	3.09	1,799.5	0.36	0.00	11	35	63,184	29		
	NEP-IC	2	14	1,398	0.0	0.0	0	7.00	99.9	0.07	0.00	2	14	1,444	1		
	NEP-OC	8	72	93,416	0.0	0.0	0	9.00	1,297.4	0.26	0.00	8	74	96,471	44		
67			9,455	16,459,092		0	0						9,764	16,997,474	7,710	0	**7,710**
77	CA-S	1	1	100	0.0	0.0	0	1.00	99.7	0.03	0.00	1	1	103	0		
	ECP-IC	3	80	165,979	0.0	0.0	0	26.67	2,074.7	0.10	0.00	3	83	171,408	78		
	ECP-OC	5	32	51,211	0.0	0.0	0	6.40	1,600.3	0.16	0.00	5	33	52,886	24		
77			113	217,289		0	0						117	224,397	102	0	**102**
Subtotal			9,628	16,770,554		0	0						9,943	17,319,123	7,856	0	**7,856**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-In[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	1	67	139,014	0.0	0.0	0	67.00	2,074.8	0.00	0.00	1	67	139,014	63		
81			67	139,014		0	0						67	139,014	63	0	**63**
Subtotal			67	139,014		0	0						67	139,014	63	0	**63**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED Vess.	Catch (lbs)	(t)	Other (t)	Total
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch								
Total	214	9,695	16,909,568	0	0	0	214	9,695	16,909,568	79,017	45	1,744	221	17,458,137	7,919	0	**7,919**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip. Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in. Total unique saleslip vessels (11) is partitioned into defined area vessels (11) and undefined area vessels (0).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel. Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost log-book tonnage estimates (0) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 2.11. Canadian albacore tuna jig-troll catch (tonnes), 2005.

Fisheries and Oceans / Pêches et Océans — Canada

2005 Albacore Tuna Catch Summary Report [Final]

North & South Pacific Source Data

Source	Vessels[1] Submitting	Unique[2] Vessels	Reported Catch[3] (lbs)	(t)
Triplogs	201	201	10,403,502	4,719
Saleslips	174	9	251,562	114
Hails	207	3		
Estimated		0		
		213	10,655,064	4,833

	Unique Vessels	Expanded Vessels
CAN	196	201
USA	154	158

North Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
61	NWP-IC	1	55	24,530	0.0	0.1	24	54.57	445.7	0.01	0.00	1	56	24,902	11		
61			55	24,530		0	24						56	24,902	11	0	**11**
67	BC	196	2,894	3,473,292	1.9	5.2	3,444	14.65	1,199.2	2.80	0.00	201	2,940	3,525,931	1,599		
	WA	144	1,174	887,233	1.4	2.1	880	8.09	755.1	2.06	0.00	147	1,193	900,679	409		
	OR	144	4,004	5,606,222	1.4	7.2	5,559	27.59	1,399.0	2.06	0.00	147	4,068	5,691,186	2,582		
	CA-N	19	47	65,251	0.2	0.1	65	2.45	1,387.2	0.27	0.00	19	48	66,240	30		
	NEP-OC	21	252	430,085	0.2	0.5	426	11.91	1,705.3	0.30	0.00	22	256	436,803	198		
67			8,371	10,462,082		15	10,375						8,505	10,620,838	4,817	0	**4,817**
77	ECP-IC	1	1	30	0.0	0.0	0	0.99	30.0	0.01	0.00	1	1	30	0		
	ECP-OC	2	2	68	0.0	0.0	0	0.99	34.0	0.03	0.00	2	2	69	0		
77			3	98		0	0						3	99	0	0	**0**
Subtotal			8,429	10,486,710		15	10,399						8,564	10,645,640	4,829	0	**4,829**

South Pacific Vessels & Catch

AREA		REPORTED[4] Defined Areas			Undefined Areas			Days per Vessel	Catch per Day	Phone-in[5] Vessels	Estimated[6] Vessels	EXPANDED[7] Vess.	Days	Catch (lbs)	(t)	Other[8] (t)	Total
FAO	DFO	Vess.	Days	Catch	Vess.	Days	Catch										
81	SWP-IC	2	111	157,955	0.0	0.0	0	55.50	1,423.0	0.00	0.00	2	111	157,955	72		
81			111	157,955		0	0						111	157,955	72	0	**72**
Subtotal			111	157,955		0	0						111	157,955	72	0	**72**

Total North & South Pacific Vessels and Catch

	REPORTED Defined Areas			Undefined Areas			Total			Catch per Vessel	Days per Vessel	Catch per Day	EXPANDED			Other	
	Vess.	Days	Catch	Vess.	Days	Catch	Vess.	Days	Catch				Vess.	Catch (lbs)	(t)	(t)	Total
Total	208	8,540	10,644,665	2	15	10,399	210	8,555	10,655,064	50,738	41	1,245	213	10,803,595	4,900	0	**4,900**

NOTES:

1 Total number of vessels submitting source information in calendar year (northern hemisphere) or November 01 to March 31 (southern hemisphere).

2 The no. of unique vessels fishing. Triplog vessels include vessels from saleslip sources where both triplog and saleslip records exist for a vessel-trip.
Unique Saleslip vessels represent vessels that only submitted saleslips and Unique Hails represent vessels that only phoned in.
Total unique saleslip vessels (9) is partitioned into defined area vessels (7) and undefined area vessels (2).

3 Reported Catch represents albacore catch attributed to Unique Vessels only. Catch is based on saleslip catch weight where landing records exist. If saleslip data are missing, then triplog catch is based on #fish x daily mean weight, or (if absent), weighted mean annual weight for area of catch.

4 Reported Vessels corresponds to the number of unique vessels that fished in each area. Some vessels may fish in more than one area. Days=Days Fished. Catch & effort from Undefined locations are allocated to specific fishing areas based on the distribution of vessels & catch for defined areas.

5 Counts for vessels for which only a phone-in record exists are allocated to fishing areas based on the distribution of vessels & catch for defined areas.

6 Estimated vessels collected from interview information are allocated to fishing areas based on the distribution of vessels for defined areas.

7 Expanded Vessels = Reported Vessels + Phone-in Vessels + Estimated Vessels. Expanded Days = Expanded Vessels x Days per Vessel.
Expanded Catch = Expanded Days x Catch per Day.

8 OTHER includes Supplemental catch + lost log book tonnage estimates (0) and Trans-shipment tonnage (0) not recorded in either saleslips or triplog catch data.

Appendix 3. Albacore Relational Database Data Table Field Properties and Data Structure – Field names, structure, data type and description, by data table.

3.1. Logbook Data – Table *Triplog*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	CFV#	Number, Long Integer	4	Canadian Fishing Vessel Number	☑	Yes (Duplicates OK)
2	TRipLogID	AutoNumber, Long Integer	4	Trip Log ID Number	☑	No
3	Trip#	Number, Integer	2	Trip number for a specific year	☑	No
4	StartDate	Date/Time	8	Start of trip	☐	No
5	Year	Text	4	Fishing Year	☐	No
6	Captain'sName	Text	45	Name of vessel Captain during the trip	☐	No
7	CrewSize	Number, Long Integer	4	Number of crewmembers	☐	No
8	GearType	Text	4	Type of gear used	☐	No
9	DaysFished	Number, Integer	2	Number of days spent fishing	☐	No
10	AreaFished	Text	10	Using the Latitude and Longitude given, Area Fished can be calculated	☐	No
11	TotalFish	Number, Integer	2	Total fish offloaded according to saleslip	☐	No
12	TotalWeight	Number, Integer	2	Total weight offloaded according to saleslip	☐	No
13	OffloadingDate	Date/Time	8	Date fish were offloaded	☐	No
14	PortCode	Text	30	Port fish were offloaded	☐	No
15	Buyer	Text	80	Buyer	☐	No
16	Hail	Text	15	Hail number	☐	No
17	MatchingFishSlip	Yes/No	1	Has a matching Fish Slip	☐	No
18	Slip#	Text	12	Fish sales slip number	☐	No
19	Plant	Text	10	DFO - Plant Number Code	☐	No
20	DataVerified	Yes/No	1	Has the data been verified?	☐	No
21	ReceiptSent?	Yes/No	1	Has acknowledgement of triplog receipt been sent?	☐	No
22	Verified?	Yes/No	1	Has this trip been checked?	☐	No
23	ImportID	Number, Long Integer	4	ArchiPelago TripHeaderID	☐	No
24	Comment	Memo	0	Remarks associated with this trip	☐	No

3.2. Logbook Data – Table *CatchData*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	TripLogID	Number, Long Integer	4	Trip Log ID Number	☑	No
2	CatchDataID	AutoNumber, Long Integer	4	Catch Data ID Number	☑	Yes (No Duplicates)
3	Date	Date/Time	8	Date of fishing	☐	No
4	HoursFished	Number, Integer	2	Hours fished that day	☐	No
5	ImportID	Number, Long Integer	4	TripHeaderID for import purposes	☐	No

3.3. Logbook Data – Table *CatchDataSets*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	TripLogID	Number, Long Integer	4	Trip Log ID Number	☑	No
2	CatchDataID	Number, Long Integer	4	Catch Data ID Number	☑	Yes (Duplicates OK)
3	CatchDataSetID	AutoNumber, Long Integer	4	Catch Data Sets ID Number	☑	No
4	Time	Date/Time	8	Time of sets	☐	No
5	Latitude	Text	6	Start latitude	☐	No
6	LatHemisphere	Text	1	Enter S or N	☐	No
7	Longitude	Text	9	Start Longitude	☐	No
8	LongHemisphere	Text	1	Enter E or W	☐	No
9	FishingArea	Text	7	Fishing Area determined by Latitude and Longitude	☐	No
10	FAOArea	Text	4	FAO Statistical Areas determined by Latitude and Longitude	☐	No
11	JigsUsed	Number, Integer	2	Number of jigs used	☐	No
12	WaterTemp	Text	5	Water temperature in F	☐	No
13	NumberOfFish	Number, Long Integer	4	Number of fish caught	☐	No
14	AvgWtofFish	Number, Long Integer	4	Average weight of fish caught	☐	No
15	OtherSpeciesName	Text	25	Name of other Species besides Albacore Tuna that was caught	☐	No
16	Other SpeciesNumber	Number, Long Integer	4	Number of other species caught	☐	No
17	Remarks	Memo	0	Remarks on weather, feet, fleet size, etc	☐	No
18	Omit?	Yes/No	1	Omit this record from catch analysis?	☐	No
19	ImportID	Number, Long Integer	4	TripHeaderID for import purposes	☐	No

3.4. Saleslip Data – Table *FishSlipHeader*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	CFV#	Number, Long Integer	4	Canadian Fishing Vessel Number	☑	Yes (Duplicates OK)
2	FishSlipsID	AutoNumber, Long Integer	4	Fish Slip ID Number	☑	Yes (No Duplicates)
3	Year	Text	4	Fishing Year	☐	No
4	Slip#	Text	12	Slip number	☐	No
5	TripNumber	Number, Integer	2	Trip number for a specific year	☐	No
6	Date	Date/Time	8	Date of Fish Slip	☐	No
7	Fisherman'sName	Text	30	Fisherman Name	☐	No
8	Buyer'sName	Text	80	Name of Buyer	☐	No
9	AreaOfCatch	Text	7	Area of catch	☐	No
10	CatchAreaFAO	Text	4	FAO Statistical Areas determined by Latitude and Longitude.	☐	No
11	DaysFished	Number, Integer	2	Number of days fished	☐	No
12	LengthOfTrip	Number, Integer	2	Length of trip	☐	No
13	Gear	Text	3	DFO - Gear Code	☐	No
14	Plant	Text	10	DFO - Plant Number Code	☐	No
15	Company	Text	4	DFO - Company Code	☐	No
16	LandingStatus	Text	3	DFO - Landing Status Code	☐	No
17	TotalWeight	Number, Long Integer	4	Total weight (lbs) of Tuna	☐	No
18	Total Value	Currency	8	Total amount paid for Tuna	☐	No
19	Quality	Text	10	Quality of fish	☐	No
20	MatchingTripLog	Yes/No	1	Fish Slip has a matching Trip Log	☐	No
21	DataVerified	Yes/No	1	Has data entered been verified?	☐	No
22	ImportID	Number, Long Integer	4	Import tag for identification purposes	☐	Yes (Duplicates OK)

3.5. Saleslip Data – Table *FishSlipData*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	FishSlipsID	Number, Long Integer	4	Fish Slip ID Number	☑	Yes (Duplicates OK)
2	FishSlipDetailD	AutoNumber, Long Integer	4	Fish Slip Data ID Number	☑	No
3	SpeciesCode	Number, Long Integer	4	Fish Species	☐	No
4	SpeciesName	Text	25	Name of Species	☐	No
5	SizeCode	Text	10	Code for fish size	☐	No
6	DFOCode	Number, Long Integer	4	DFO code	☐	No
7	Pieces	Number, Long Integer	4	Number of Fish	☐	No
8	Weight	Number, Long Integer	4	Weight (lbs) of fish	☐	No
9	DFOForm	Number, Long Integer	4	DFO Form Code	☐	No
10	PricePerPound	Currency	8	Ex-vessel price per pound	☐	No
11	Value	Currency	8	Ex-vessel dollar value	☐	No
12	ImportID	Number, Long Integer	4	Import tag for identification purposes	☐	Yes (Duplicates OK)

3.6. Hail Data – Table *VesselFishingYears*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	VesselID	Number, Long Integer	4	Vessel ID Number	☑	No
2	FishingYears	Text	4	The year a vessel fished tuna based on information received by F&O (e.g. trip log, sales slip, fish ticket, record from other agency, phone-in to F&O at start of season, etc).	☐	No
3	CalledIn	Yes/No	1	This means that the vessel owner/operator called in to say that they would be tuna fishing, or for 1998, they completed a questionnaire stating that they fished albacore in 1998.	☐	No
4	DateCalledIn	Date/Time	8	Date vessel called in	☐	No
5	TripLog	Yes/No	1	A check means that F&O has a minimum of one Trip Log on file for that vessel.	☐	No
6	NumberOfTripLogs	Number, Long Integer	4	The number of Trip Logs F&O has for that vessel for that year.	☐	Yes (Duplicates OK)
7	FishSlip	Yes/No	1	A check means that F&O has a minimum of one Sales Slip (Fish Ticket) on file for that vessel.	☐	No
8	NumberOfFishSlips	Number, Long Integer	4	Lists how many Fish Slips F&O has for that vessel for that year.	☐	Yes (Duplicates OK)
9	FishingYearID	AutoNumber, Long Integer	4	Fishing Year ID Nimber	☑	No

3.7. Supplemental Data – Table *SupplementalData*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	ID	AutoNumber, Long Integer	4	Record ID	☐	Yes (Duplicates OK)
2	Vessel	Text	255	Vessel name	☐	No
3	VRN	Number, Long Integer	4	Vessel registration number	☑	No
4	Year	Number, Integer	2	Year of catch	☑	No
5	AddToTotalCatch	Number, Single	4	Supplemental catch to add to total landings	☐	No
6	AddToUSCatch	Number, Single	4	Supplemental catch to add to U.S. landings only	☐	No
7	NewTotalCatch	Number, Single	4	Total landings including supplemental catch	☐	No
8	NewTotalUSCatch	Number, Single	4	Total U.S. landings including supplemental catch	☐	No
9	Comment	Text	100	Comments associated with this record	☐	No
10	Updated	Date/Time	8	Date of update	☐	No

3.8. Trans-shipment Data – Table *Transhipments*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	Year	Text	4	Catch year	☑	No
2	FAOArea	Text	7	FAO area where transhipments were obtained	☑	No
3	Tonnage	Number, Long Integer	4	Transhipments from this FAO area in metric tonnes	☐	No
4	Update	Date/Time	8	Date of update	☐	No
5	Comment	Text	255	Remarks	☐	No

3.9. Estimated (unreported) Vessels Data – Table *UnreportedVesselCount*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	Year	Text	4	Fishing year	☑	No
2	Hemisphere	Text	5	Fishing location	☑	No
3	UnreportedVessels	Number, Long Integer	4	Number of vessels	☐	No
4	Update	Date/Time	8	Date of update	☐	No
5	Comment	Text	255	Comment associated with this record	☐	No

Appendix 4. Albacore Relational Database Lookup Table Field Properties and Data Structure – Table field names, data field properties, structure, data type and description, by lookup data table.

4.1. Area Codes – DFO Fishing Areas – Table *CatchAreaOrder*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	CatchOrderID	AutoNumber, Long Integer	4	Record ID	☑	Yes (No Duplicates)
2	CatchAreaOrder	Number, Long Integer	4	DFO Catch Area sort sequence	☐	No
3	CatchAreaShort	Text	7	DFO Catch Area abbreviated (ex. BC)	☐	No
4	CatchAreaLong	Text	25	DFO Catch Area (ex. British Columbia waters)	☐	No
5	FAOAreaShort	Text	4	FAO Catch Area abbreviated (ex. 67)	☐	No
6	FAOAreaLong	Text	25	FAO Catch Area (ex. Northeast Pacific)	☐	No
7	FAOAreaOrder	Number, Long Integer	4	FAO Catch Area sort sequence	☐	No

4.2. Area Codes – FAO Fishing Areas – Table *FAOAreaOrder*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	FAOCatchOrderID	AutoNumber, Long Integer	4	Record ID	☑	Yes (No Duplicates)
2	FAOCatchAreaOrder	Number, Long Integer	4	FAO Catch Area sort sequence	☐	No
3	FAOCatchAreaShort	Text	4	FAO Catch Area abbreviated (ex. 67)	☐	No
4	FAOCatchAreaLong	Text	25	FAO Catch Area (ex. Northeast Pacific)	☐	No

4.3. Buyer Codes – Table *BuyerInformation*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	BuyerID	AutoNumber, Long Integer	4	Buyer Information ID Number	☑	Yes (Duplicates OK)
2	Buyer	Text	50	Name of Buyer (Company)	☐	No
3	Contact Person	Text	30	Person to contact at Company	☐	No
4	Address	Text	45	Address of Company	☐	No
5	City	Text	30	City of Company	☐	No
6	Province/State	Text	4	Province or State of Company	☐	No
7	PostalCode	Text	8	Postal Code of Company	☐	Yes (Duplicates OK)
8	ZipCode	Text	15	US Postal Code	☐	Yes (Duplicates OK)
9	Telephone	Text	14	Telephone number of Company	☐	No
10	Fax	Text	14	Fax number of Company	☐	No
11	Notes	Memo	0	Comments relevant to Buyer (alternate contact, etc.)	☐	No
12	LastUpdated	Date/Time	8	When the Buyer was last updated	☐	No

4.4. Port Codes – Table *OffloadPorts*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	PortID	AutoNumber, Long Integer	4	Offloading Port ID Number	☑	Yes (Duplicates OK)
2	PortCode	Text	5	Code to describe offloading ports	☐	Yes (No Duplicates)
3	OffloadingPort	Text	30	Name of offloading port	☐	No

4.5. Vessel Codes – Table *VesselInformation*

#	Field Name	Data Type	Size	Description	Primary Key	Indexed
1	VesselID	AutoNumber, Long Integer	4	Vessel ID Number	☑	No
2	CFV#	Number, Long Integer	4	The unique Canadian Fishing Vessel number assigned by F&O.	☑	Yes (No Duplicates)
3	VesselName	Text	30	The name of the vessel as provided by the owner/operator to F&O through the Vessel Licensing Unit.	☐	No
4	HomePort	Text	25	Vessel Home Port	☐	No
5	RadioSign	Text	10	The radio call sign provided by the vessel owner/operator.	☐	No
6	Registration#	Text	15	The unique Canadian Vessel registration number assigned by the Canada Department of Transport.	☐	No
7	Licence	Text	10	Type of Fishing Licence	☐	No
8	GrossVol	Number, Double	8	Gross Volume	☐	No
9	GRT	Number, Double	8	Vessel Gross Registered Tonnage (GRT) in metric tonnes. Estimate of the Gross Metric Tonnage of Vessel from Conversion Table.	☐	No
10	OALen	Number, Double	8	Vessel overall length in metres.	☐	No
11	Breadth	Text	10	Also called Beam. Vessel width in metres.	☐	No
12	Depth	Text	10	Vessel draft in metres	☐	No
13	Hull	Text	10	Vessel hull material: steel (STL), fibreglass (FBGS), wood (WOOD)	☐	No
14	EngineHP	Number, Double	8	Horsepower of the vessel's main engine.	☐	No
15	Prop	Text	10	Propulsion	☐	No
16	GearCode	Number, Double	8	Type of Fishing Method or Methods	☐	Yes (Duplicates OK)
17	CompanyName	Text	40	Company Name	☐	No
18	Salutation	Text	2	Salutation	☐	No
19	OwnerLast	Text	30	Owner Name	☐	No
20	OwnerFirst	Text	30	Owner Name	☐	No
21	Address	Text	50	Address	☐	No
22	City	Text	30	City	☐	No
23	Province	Text	2	Province	☐	No
24	PostalCode	Text	7	Postal Code	☐	Yes (Duplicates OK)
25	Telephone	Text	15	Telephone Number	☐	No
26	Fax	Text	15	Fax Number	☐	No
27	Email	Text	50	E-mail Address	☐	No
28	Comments	Memo	0	Comments associated with this vessel	☐	No
29	CurrentlyLicensedUS	Yes/No	1	Yes if the vessel is currently licensed & has fished in the U.S. (with two exceptions (Freeland and Melville))	☐	No
30	TriplogReceiptSent	Yes/No	1	Owner has been sent an acknowledgement of receipt of triplogs? (cleared annually)	☐	No